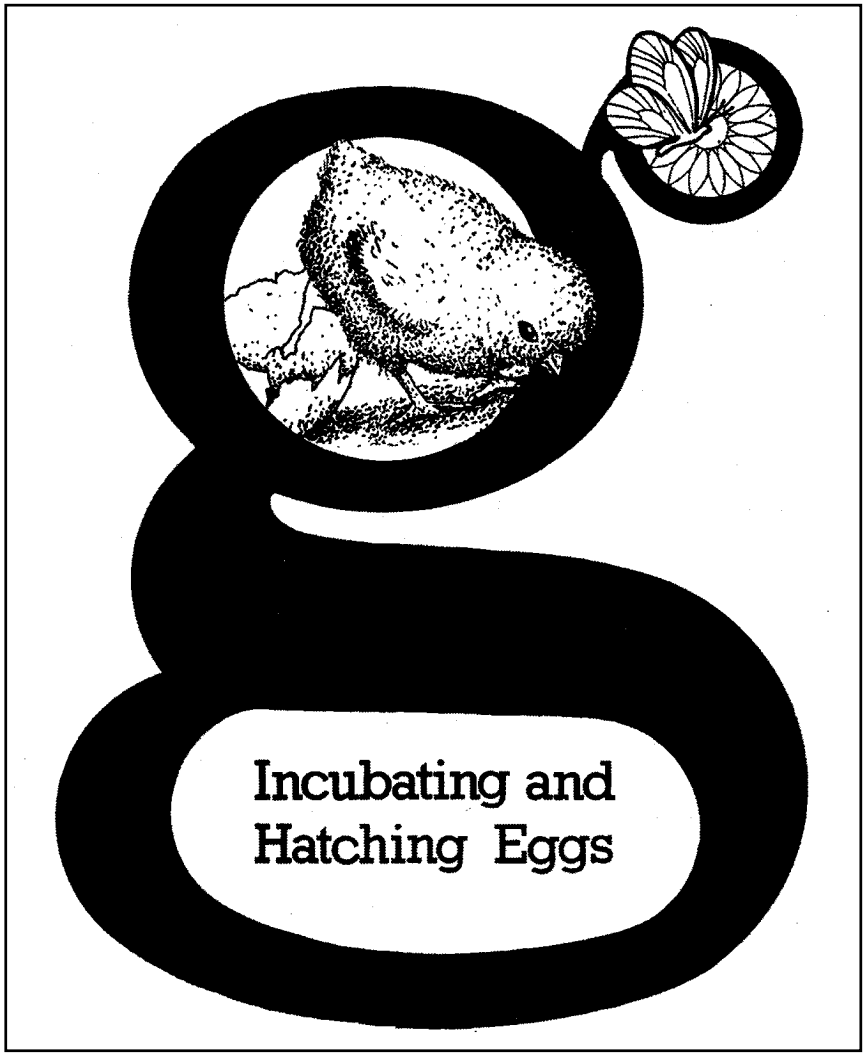
GUIDE

CLEAPSS

Incubating and Hatching Eggs

L71



L71 Incubating and Hatching Eggs

Contents

This guide is a revision of CLEAPSS guide L71, originally published in March 1997.

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This guide combines material from the first edition of CLEAPSS guide L71 and information originally published in the *Guidelines* series by the ILEA Centre for Life Studies, hence the 'g' on the front cover. Following the closure of the Centre, the School Science Service has acquired the copyright of all the CLS publications.

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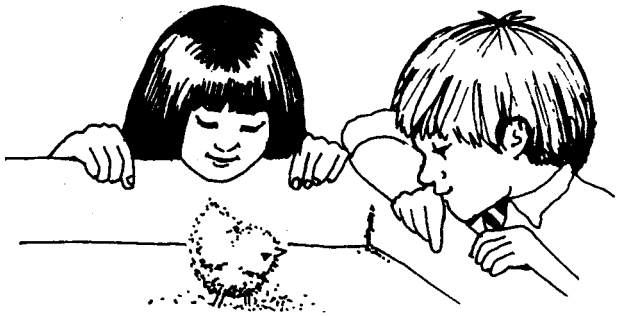
L71 INCUBATING and HATCHING EGGS

1. INTRODUCTION



Anyone who has successfully incubated eggs in a school will recall all the excitement and enthusiasm shown by both pupils and staff, patiently waiting, like expectant mothers, for the hatching day on which the small birds would peck their way out into the outside world. Such a project will provide a focus for a whole variety of both scientific and creative activities. It can provide support for aspects of work in several areas of the National Curriculum, including science, mathematics and English, as well as PSE, art and so on. Some suggestions for the types of activities that are appropriate for pupils in key stages 1, 2 and 3 are given later in section 10 *Studying Eggs and Chicks*.

Careful planning and an appreciation of what will be involved in the project are, of course, needed to avoid problems.

WHAT THIS GUIDE IS ABOUT

Guide L71 outlines the arguments for incubating eggs and identifies the difficulties and other points to consider ***before starting***. It includes a discussion of sources of eggs and equipment, a review of incubators and how to set them up, a guide to the care and handling of the eggs and the rearing of hatched birds, and also gives details of sources of information and some learning materials. In short, the guide provides all the necessary information to enable successful, safe and humane studies of the development of young birds.

Most of this information concentrates on work with the eggs of the domestic fowl or chicken, *Gallus domesticus*, as these are likely to be the most readily available. All further reference in this booklet to eggs or young birds will apply to this species, unless other animals are named. Studies of ducks or other domesticated birds are also possible, however, and much of the guidance given here will be equally appropriate for these birds too, (though we recommend that experience should be gained first with the eggs of chickens).

TO INCUBATE OR NOT TO INCUBATE?

There are, however, some who argue that incubating and hatching eggs should ***not*** be attempted in schools because it will be impossible to *guarantee* that no animal could ever suffer any harm or that animals have rights and that they should not be 'used' to satisfy human interests, including education. Such a 'hands-off' approach to work with eggs and chicks (which can be extended to the study of *any* animals in school) will, however, deny pupils the opportunity of gaining at first hand a true appreciation of the requirements and behaviour of living animals. It will also not help schools in their efforts to promote a general respect for life and, in particular, caring and responsible attitudes towards animals kept as pets at home or encountered outdoors.

PROMOTING A RESPECT FOR LIFE

Dealing with any form of life, of course, demands considerable care and fertilised eggs are no exception. If teachers decide that they ***do*** wish to incubate eggs, they must be fully informed and prepared for every eventuality, to ensure the humane treatment of animals. This guide aims to help schools and teachers meet this requirement.

ONLY STUDY DOMESTICATED BIRDS SUCH AS CHICKENS OR DUCKS

It is important to realise that studies of the development of any *wild* British bird which involve taking eggs, chicks or adults from their natural environment are illegal and **must not** be contemplated. This does not apply to imported foreign species but there are restrictions on the types of foreign birds that are appropriate for schools and in most cases these animals would not be suitable anyway for detailed studies of development.

2. BEFORE YOU START...

Before attempting to incubate and hatch eggs it is ***essential*** that schools consider what is required to hatch chicks successfully and what will happen to the adult birds once they have emerged. Listed below are the major considerations that you must have addressed ***before*** starting a project to incubate some eggs. You will find more details in later sections, as indicated.

DO I NEED TO OBTAIN APPROVAL?

Approval of the headteacher is needed as aspects of the project could well affect normal school life. It is also a good idea to involve other teaching staff and then much of the workload can be spread among several people. This has obvious advantages and provides a back-up team if needed. If **you are teaching in a Local Authority establishment**, it is possible that there may be some local restrictions on egg incubation, keeping animals or rearing livestock outdoors, though these should already have been sent, in writing, to schools.

WHAT WILL HAPPEN TO THE BIRDS THAT HATCH?

Unless you are planning to keep the adults at school, are confident that they can be provided with the long-term care required, and have checked that there are no restrictions on keeping poultry outdoors, it will be necessary to arrange a home for the hatched birds, ***in advance***. It is inhumane and illegal to consider releasing unwanted chicks or ducks into the wild. You must also be aware that someone may take your chicks but surplus males may then be used for food, as they don't lay eggs. **See sections 6.4 & 8** for discussion of the options.

HOW LONG WILL I NEED TO ALLOW FOR THE PROJECT?

Think carefully about the timing of the incubation project during the school term to ensure that the eggs will hatch when pupils will be present and not during a weekend or half-term holiday! For the eggs of chickens, the incubation period is 21 days. You need to start incubating hens' eggs midweek; eggs first placed in the incubator on a Monday should hatch on a Sunday and the event may be missed.

Don't forget that you may need to keep the chicks that hatch for up to 6 weeks, so make sure you don't run into a holiday period. Allowing a week for setting up the incubator and introducing pupils to the project, and a minimum of one week after hatching to allow the chicks to become established, ***at least 5 weeks*** unbroken schooling is required. Depending on when someone can take the chicks from you and how much work you hope the hatched chicks will stimulate, a longer period may be needed.

For the eggs of other birds, such as ducks, you will need to adjust your timings as their incubation periods are different. Remember too that from some sources, eggs can only be supplied when they become available; other sources may be able to supply on a specific date, if sufficient notice is given.

See sections 5.2, 6 and 10 for detailed information.

HOW MANY EGGS SHOULD BE INCUBATED?

This will depend partly on the size of the incubator that you already have purchased or intend to borrow. From some sources, there may be a minimum number of eggs that can be ordered; will this be too many? Incubate too few eggs and you may have a disappointingly low success rate (eggs from some sources cannot be guaranteed to be fertile). Incubate a larger number of eggs and, if you're successful, you may have too many adults to find homes for. For most situations, a minimum of 12 eggs and a maximum of 24 eggs will be appropriate. **See section 4.2** for the capacity of incubators currently on sale.

WHAT'S THE BEST TIME OF YEAR TO INCUBATE EGGS?

There are a number of advantages in starting your incubation project in the spring. Eggs obtained from free-range hens or from birds kept in natural light are more fertile and their hatchability is highest at this time of year. Fertile egg suppliers may only have eggs available for a limited period beginning in March. But if you are borrowing equipment, remember that others will probably also want to incubate in the spring, so competition will be higher then! Avoid incubation during the winter months if at all possible; incubators of the types used in schools may not be able to maintain constant conditions because of drastic falls in temperature at night or weekends if the heating system does not operate continuously.

WHAT ABOUT CARING FOR THE EGGS AND CHICKS AT WEEKENDS?

Involvement of the school premises or site manager is essential. Access to the school premises at weekends will be needed some of the time. Even if the incubator has an automatic egg turner (or the premises manager can be persuaded to turn the eggs at weekends), the chicks will need attention once they have hatched. Arrangements *might* be made to transport a non-turning incubator home at weekends but this will depend very much on its type or size and this is far from ideal anyway. Acquiring a key for access to the building for the duration of the project would cause the least inconvenience to the premises manager but this is not always possible. The premises manager can also help to ensure that the incubator is not accidentally turned off by cleaners etc. A label stating "Please leave on" near the plug socket will help too.

WHAT WILL BE NEEDED AND ARE THERE SUFFICIENT FUNDS AVAILABLE?

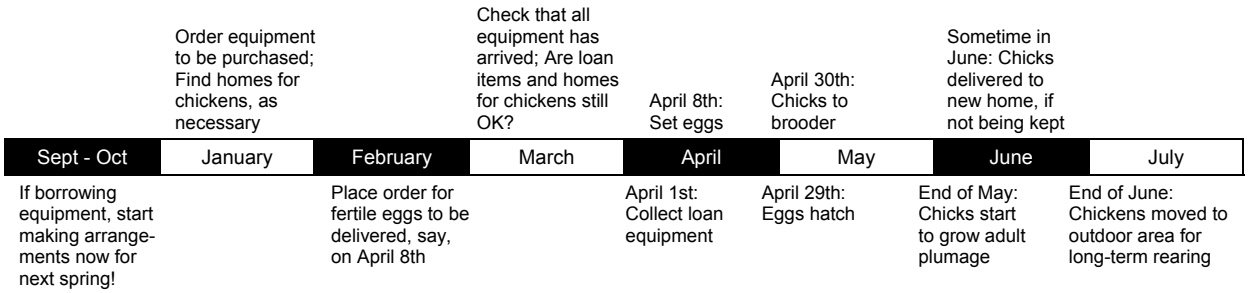
Ensure that all the required equipment is available: incubator, brooder (or materials to construct one), chick food, etc; **see sections 4, 6.2 and 6.3**. Much of this can sometimes be borrowed or hired (**see section 4.1)** but demand for these items invariably exceeds the amount of equipment available for loan, so it is vital to plan many months ahead. Make sure that borrowed equipment is available for the time required, including at least one week prior to starting incubation so that the temperature control can be tested. Make sure that the school is prepared to meet the financial costs of any items that need to be bought, eg, the eggs (and possibly their delivery charge), the brooder lamp and the chicks' food (young chicks eat a tremendous amount!).

WHAT IF SOMETHING SHOULD GO WRONG?

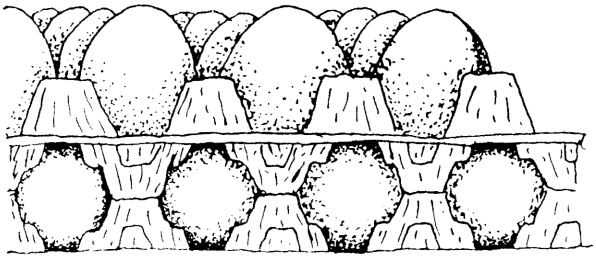
In advance, try to locate someone in the area who has had first-hand experience of incubating eggs as he / she may prove helpful in the event of some emergency or problem. Teachers' centres and advisers may be able to suggest contacts. You must accept responsibility for the welfare of the eggs and brood. In advance, identify the location of a local vet and the hours when the surgery is open, in case you need to make arrangement for urgent attention to a chick in distress. Think carefully about whether you and the children will be able to cope if problems arise, eg, the hatching of a deformed chick. You will need to prepare pupils for the possibility that this might happen.

To help in the planning of your incubation project, Figure 1 gives an indication of the timing of various events. This assumes that the project will start in the spring; for work at other times of the year, make appropriate adjustments.

Figure 1 An incubation project 'time line'



3. SOURCES OF EGGS



OBTAINING FERTILE CHICKEN EGGS

There are a few commercial educational suppliers known to CLEAPSS.

Timstar Laboratory Suppliers (mentioned in the previous edition) no longer supplies fertile hens' eggs.

The Domestic Fowl Trust will supply and deliver fertile hens' eggs for a limited period from the beginning of March to any mainland UK address. The cost is £1 per egg and the delivery charge is £14.50 (2005 prices).

Ivan Mears supplies fertile eggs; supplier's choice eggs cost £5 per dozen; eggs with blue or green shells £10 per dozen and ones that are sex-linked (from white males and brown females) also £10 per dozen. Eggs can be collected or delivered (£6 charge per dozen, next day delivery). The supplier will also take back hatched chicks. It is best to speak directly with the supplier rather than use the web site.

P and T Poultry also supplies pure-breed fertile eggs, either as quantities of a particular breed or mixtures of breeds. Light Sussex and Maran eggs can be provided throughout the year, all others in a limited period from March. Costs are £8 - £9 for 6, delivery extra unless the eggs are ordered at the same time as an incubator.

Wheatcroft also supplies standard eggs from March onwards as well as the eggs of specialist breeds. The cost of the standard eggs is £12 per dozen including postage.

There is an organisation, established in January 2005, called **Living Eggs.** This will provide all the materials needed for the hatching of eggs and operates on a franchise basis. Contact the head office or look at the web site (bookings section) to find out if there is a franchise near you. The price for the service starts at £225.

TRACKING DOWN LOCAL SOURCES: USE *YELLOW PAGES*

There are, of course, many other sources of fertile eggs; the problem sometimes is locating them! *Yellow Pages* can be consulted for local supplies (look under 'Egg Merchants', 'Egg & Poultry Packers', 'Farmers' and 'Poultry Farmers'); remember to specify *fertilised* eggs when you ring!

WEB SITE LIST OF EGG SUPPLIERS

Just as this guide was about to be printed we discovered a very useful, and extensive, list of suppliers of fertile eggs on the Brinsea Products' web site. This list is buried away in the information about a new incubator which appeared on the market too late for us to consider for this guide - the R-Com digital incubator. To find the list, go to the Brinsea UK web site, scroll down to the 'Incubator Packs' section, click on the R-Com digital incubator and click on the link to the list. The URL for this list of egg suppliers is currently: www.brinsea.co.uk/uk/products/rcomeggs.html.

CITY FARMS

Local farms are often a fruitful source, including some city farms in urban areas. The National Federation of City Farms and Community Gardens produces a listing of establishments; contact the NFCFCG web site to find out if there is a city farm near you.

FERTILE DUCK EGGS

Kortlang and Kortlang supplies fertile duck eggs. The minimum order is one dozen eggs and delivery (an additional charge) is arranged via Amtrak. Check which variety of duck can be supplied and ask what the incubation period is, since this will vary depending on the variety.

FARMING AND COUNTRYSIDE EDUCATION (FACE)	FACE has information on its web site; there are farms to visit, which may also be able to supply fertile eggs There are also fact sheets and teaching materials in the resources section.
COLLEGES OF AGRICULTURE	There is a college of agriculture in most counties in England and Wales (or a further education college with an agriculture department). These may be able to supply eggs or suggest other local sources; your local authority or CLEAPSS should be able to give you the address of the nearest college. It is also a good idea to ask your local teachers' or science centre for suggested local sources of fertile eggs.
CHECK THE 'SMALL ADS' COLUMNS OF SPECIALIST PUBLICATIONS	Advertisements for suppliers of fertile eggs are sometimes found in the pages of *Cage & Aviary Birds*, the 'Homes & Gardens' section of *Exchange & Mart* and also the monthly publication *Smallholder.* These advertisements are also a good way of tracking down suppliers of eggs of other birds such as ducks, turkeys, geese etc. Contact a local newsagent and order a single copy, if not readily available.
TRANSPORT AND STORAGE OF EGGS	If eggs have to be delivered, rather than collected, arrangements are best made using Amtrak. Fertile eggs which are kept cool (between 10-15 °C) will not begin their development and it is claimed that they can be stored or transported[1] for a period of up to 7 days without significant losses. It is best, however, to begin incubation as soon as possible after the eggs are laid.

[1] During storage or transport, despite claims from various sources that the broad end of an egg should be pointing upwards (or downwards), research has indicated that the orientation of the egg has little effect on subsequent hatching or survival.

4. INCUBATORS

BASIC REQUIREMENTS FOR NORMAL DEVELOPMENT AND HATCHING

To develop and hatch, eggs require the following factors to be controlled.

- **Warmth** - to encourage the embryos to develop at the natural rate, the eggs of different species requiring a different optimum temperature.
- **Humidity** - to control the normal weight loss of the egg that must occur during incubation for successful hatching and to prevent egg shell membranes becoming too dry for hatching. Different humidity levels need to be provided at certain stages of incubation, with a very high humidity at the time of hatching.
- **Ventilation** - to ensure a good supply of oxygen and, most importantly, to remove the carbon dioxide produced so that it does not poison the developing chicks. An appropriate air flow also encourages evaporation of water for the essential weight loss of the egg.
- **Turning** - at regular intervals, to prevent the egg membranes from sticking to the inside of the shell and to ensure the eggs warm evenly. Egg turning also increases the oxygen intake of the embryo and so encourages development.

USING COMMERCIAL INCUBATORS TO SIMULATE NATURAL CONDITIONS

In natural situations, all these requirements would, of course, be provided by the broody hen. In an artificial environment they must be provided by the **incubator**, under the operator's control. Maintaining the conditions around the eggs is a 24-hour job; any error could result in death of the developing birds.

There are various designs of egg incubators available commercially; small, normally still-air, models are the most suitable for school use. 'Home-made' incubators may not provide adequate regulation of all the critical conditions and may therefore reduce the success rate of hatching. Commercial hatcheries usually hatch around 80% of hen's eggs. In schools, the success rate may be somewhat lower than this. Some of the egg suppliers, such as P and T Poultry, also provide advice online.

IMPORTANT FEATURES OF AN EGG INCUBATOR FOR SCHOOL USE

Turning the eggs needs to be carried out at least twice a day, *including at weekends*. Because of this, an automatic egg-turning facility for the incubator is a very high priority. (This can be switched off during the day if pupils are to turn eggs manually.) For school use, an incubator should be durable, electrically safe and also provide a reasonable view of the incubating eggs. Not all incubators are therefore suitable and a number of models cannot be recommended; (**see section 4.2** which evaluates commercial egg incubators).

4.1 Borrowing or hiring an incubator

Borrowing (or hiring) an incubator is possible, though demand may outstrip supply, so plan early! (See Figure 1.) **You will need to borrow / hire an incubator for a period of at least 4 weeks.** Sometimes the cost of hiring an incubator is greater than the purchase of equipment, so check prices carefully.

TRACKING DOWN INCUBATORS FOR LOAN

A good place to start looking is a local teachers' or science centre; some may have a loan collection of incubators or may be able to suggest suitable sources. Try contacting neighbouring schools, both primary and secondary. In the past, incubating eggs was a feature of several introductory secondary science courses. A school science department might therefore have an incubator which is no longer used.

Rural and city farms may have incubators for loan (often as part of a 'package' including fertile eggs) and agricultural colleges are also often valuable contacts; **see section 3** for details.

Suppliers who sell incubators may also offer them for hire. For example, Hatch-it Incubators (**see section 12**) is introducing two hire kits, based on the Brinsea Octagon 10 and 20 incubators (**see section 4.2**).

LOANED INCUBATORS MAY NOT MATCH YOUR REQUIREMENTS

It will not normally be possible to pick and choose, so the most suitable model may not be available. Older incubators (often those most likely to be offered for loan) may not possess features which have improved the efficiency of current models and may not have been well maintained, so hatching success could be reduced. Automatic turning may not be provided, so what will happen at weekends? Will the capacity of the incubator match the number of eggs you had decided to incubate? Older incubators which use an outdated wafer-type thermostat (which looks like bellows) may exhibit unsatisfactory temperature fluctuations unless working at full capacity. If this type of incubator is available for loan, incubating more, rather than less, eggs is preferable (but then you could have more adult birds on your hands!).

Before going too far in setting up your project, decide how much you are prepared to alter your initial ideas and requirements.

SOME TIPS WHEN BORROWING OR HIRING AN INCUBATOR

Using a loaned egg incubator can be a bit of a lottery, so here are some points to remember. If in doubt, it may be wiser to refuse the incubator offered.

- If hiring, look at the **total** cost for the time you will need the incubator. Check for delivery costs, deposits and insurance too. Check on other items provided with the loan service, for example, items for brooding, feeding and watering (**see section 6.2**). If they are not supplied, you will have to provide these facilities yourself.
- Check any borrowed equipment carefully; it may not have been used for a long time or been given regular routine checks. Therefore, thoroughly test all borrowed incubators for safety, inspecting the state of the wiring and plug. Arrange for a portable-appliance test unless you have evidence that this has been done recently. Clean all parts according to the manufacturer's instructions (**see section 5.1**).
- Avoid 'home-made' incubators unless you know they have a good track record in hatching eggs successfully.
- Allow plenty of time to check the correct functioning of the thermostat. Also, the incubator may have lost its own thermometer and you may need to obtain one from another source[2].
- Insist on obtaining a copy of the manufacturer's instructions with the incubator. Without these, it will be very difficult to ensure successful hatching, as only the manufacturer will know exactly how best the incubator should be operated to produce the necessary conditions.

4.2 Purchasing an incubator

BASIC TYPES OF EGG INCUBATOR

As might be expected, commercial egg incubators are available to suit most pockets and the requirements of amateur and professional users. There are two main types of incubators: the still-air variety which relies on convection for ventilation and forced-air models which may be larger and more expensive. Many models of incubator that are suitable for schools are of the still-air type.

ESSENTIAL / DESIRABLE FEATURES OF AN EGG INCUBATOR

Before deciding which incubator to buy, you should consider the following.

- ❒ How will the incubator stand up to the rigours of use in schools? Is its construction likely to be durable?
- ❒ Is the incubator electrically safe? At the School Science Service, we have inspected some of the models currently on sale and for those we have looked at and passed, we can be confident about their safe construction. Models we have *not* inspected may nevertheless be electrically acceptable. In the discussion of individual models, summarised in Table 1 and described on subsequent pages, we are satisfied with their electrical safety.

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[2] To ensure that a thermometer will be sufficiently sensitive and accurate over the range 35 - 45 °C, it is important to use one which has been made for use with an incubator. All the incubator manufacturers and suppliers also list various types of thermometer, specifically produced for such work. Wet- and dry-bulb thermometers are often recommended, as these also measure humidity. However, such readings are very inaccurate and we do not feel that wet- and dry-bulb thermometers are particularly useful.

ESSENTIAL / DESIRABLE FEATURES OF AN EGG INCUBATOR (continued)

- ❒ How easy is it to see the incubating eggs? Since a major reason for starting an incubation project is to enable pupils to watch the eggs hatching, an unobstructed view will normally be a high priority.
- ❒ Does the incubator have the facility to turn the eggs automatically? The eggs ***must*** be turned regularly and although pupils can do this manually during the day, it is helpful if eggs are also turned at night and essential at weekends, if a reduced success rate is to be avoided. Without automatic egg turning, someone will have to come in to school at weekends or the incubator must be taken home. During transport, damage may be caused to the delicate organs and membranes of the chicks within the developing eggs.
- ❒ Does the incubator have an appropriate egg capacity? Some models are very large while others are almost too small. In deciding which incubator is most suitable for your needs, it is important not to underestimate the capacity which will be needed but, again, do remember that the more eggs you hatch, the greater your problem may be in finding all the birds a home.
- ❒ How heavy is the incubator? This could be important if you have to take it home to turn eggs at the weekend. Large and heavy incubators could create storage problems.
- ❒ Will the incubator be immediately available? There may be a delay in the supply of some incubators which are imported or cannot be manufactured fast enough at times of peak demand. We would suggest that before placing an order, obtain *in writing* a statement of how long it will be before the item will be delivered.
- ❒ How much can be afforded? It could be a big mistake simply to buy the cheapest incubator; it may not meet one or more of the important criteria discussed above. A more appropriate strategy is to choose the incubator that meets your needs and then see if your budget can stretch a little, if necessary. In the pages which follow, we have not included the more expensive incubators (though some suggested models are still quite costly).

INCUBATORS TO ***AVOID***

We do ***not*** recommend a number of models of incubator, some of which are on the market. These include ones made from expanded polystyrene and ones which are electrically unsafe.

The Ecostat Economy range, as supplied by Ascott, is made from expanded polystyrene and such incubators are unlikely to be durable in typical school use. The models include PY63, (80 egg capacity, manual turn), PY242 (45 egg capacity, semi-automatic), PY243 (45 egg capacity, automatic), and those known as Ecohatch PY64 (60 egg), PY244 (30 egg, push rod semi-automatic) and PY245 (30 egg, automatic). Furthermore, an earlier version of the Eco-hatch incubator did ***not*** pass our electrical tests.

The Hovabator range, as supplied by Solway feeders, model 1360 (60 egg capacity, manual turning, still-air incubator), failed our electrical tests. This supplier also sells the Solway 24 (a 24 egg, semi-automatic incubator), which also failed electrical tests.

The Marsh Turn X7A was featured in the 1997 guide. It is manufactured in the USA and is difficult to obtain. Therefore we have not included it in this revision.

INCUBATORS SUITABLE FOR MOST SCHOOL USES

Table 1 on page 10 summarises the models of incubator currently available that are potentially most suitable for schools to use. ***The incubators listed have been examined by the CLEAPSS School Science Service and all should be electrically safe.*** A new Brinsea model, the *R-Com Digital*, arrived too late to be included here; it is perhaps too small for schools with only a 3-egg capacity! If schools wish to incubate eggs on a larger scale than can be accommodated in the incubators listed in the table, all the manufacturers supply models which will hold a greater number of eggs. Prices, naturally, are considerably higher than for the models described here; contact the manufacturer or sole source for details.

One strange feature is that the cost of Brinsea incubators may be cheaper from some suppliers than the manufacturer. This is because of bulk-order deals negotiated by the supplier. Also some suppliers have special offers from time to time, so it is worth contacting them directly to establish the current costs. Prices are those quoted by suppliers in November / December 2005 but could already have changed!

DON'T FORGET SPARES and ACCESSORIES

When ordering your incubator, it is wise to purchase an additional *incubator* thermometer in case of breakage. You may also need other items for candling eggs, brooding and feeding chicks etc and you may wish to order some of these from the same source. This may help avoid small-order delivery charges.

DELIVERY CHARGES

These vary greatly.

Ascott delivery to mainland England, Wales and lowland Scotland is included in prices.

Banbury Cross delivery is included on some models, at cost on others.

Brinsea delivery is £4.50 on orders below £75 and £7.00 on orders above £75.

Dog Health delivery is £7.50.

The **Domestic Fowl Trust** delivery is £8.30.

Gamekeepa delivery is £11.00.

Griffin Education has no delivery charge to schools in the UK (other than those on offshore islands) for orders over £50; below this there is a £10 handling charge.

Philip Harris charges £6.95 on all orders.

Rob Harvey prices include delivery.

Hatch-it Incubators has prices which include delivery on all but Maino models.

Interhatch has no delivery charge.

Insectlore charges £3.95 on orders up to £250; above that, delivery is free.

P and T Poultry has a delivery charge that depends on weight; it is £7.95 for orders weighing up to 30 kg.

Solway Feeders delivery charge depends on the weight of the order.

Wheatcroft delivery charge is £12.50.

A comparison of egg incubators

Information about the incubators we feel are potentially of most interest is provided in Table 1 and on the following pages, to help schools decide if a particular model is suitable for their needs. Cost may be the most crucial deciding factor, but schools should appreciate the limitations that may be imposed by going for the least-expensive option. Information on Curfew models is included even though we have doubts about supply; consequently we have not included details of prices and they do not feature in Table 1.

Prices quoted mostly include VAT. Remember to check the delivery charge.

COMPLETE KITS

A number of suppliers provide kits containing all the equipment needed for incubation and brooding. These often represent remarkable value for money when compared with the total cost of purchasing items separately. Different suppliers have the same kits but sometimes give them different names. Some kits are produced specifically for the home market (eg, Ascott kits); others, such as those from Griffin and Harris, have lesson guidance and are more suited to schools. Table 2 overleaf gives details of some of these kits.

D-I-Y KITS

There are several available including the Ecostat Incubator kits (available from the Domestic Fowl Trust and Ascott) and the Interhatch Kit (available from Interhatch). These may seem good value but will take time to construct and you will often have to find important supplementary parts for yourself; for instance, the Ecostat Incubator kit for 25 eggs comprises only the electrical components, thermometer and instructions, there is no incubator box.

Table 1 Egg incubators most suitable for use in school

Model	Manufacturer	Source[1]	Lowest price (inc VAT)	Capacity (hens' eggs)	Automatic turning	Portability	Observation of eggs
Hatchmaker	Brinsea Products	A; BC; BP; DF; HI; IH; P;T S; W	£110.00	36	No	Small and light	Poor
Octagon 10	Brinsea Products	A; BC; BP; DF; GF; GE; HI; IH; IL; PH; PT; S; W	£69.71; £120.86*	10	Yes; with cradle*	Very light but needs care	Partially restricted
Octagon 20 DX	Brinsea Products	A; BC; BP; DF; GF; GE; HI; IH; PH; PT; S; W	£116.21; £139.95*	24	Yes; with cradle*	Light but needs care	Somewhat restricted
Polyhatch	Brinsea Products	A; BC; BP; DF; GF; HI; IH; PT; S; W	£179.99	42	Yes	Large but OK	Quite poor
Covatutto 7	Novital	A; DF; DH; IH; PT	£40.38	6-7	No	Small and light	Somewhat restricted
Covatutto 16	Novital	A; DF; DH; IH; PT	£50.57	12-16	No	Small and light	Somewhat restricted
Covatutto 24	Novital	A; DH; IH; PT	£108.37	20-24	No	Heavy, but possible	Good
MPS12	Maino	BC; HI; PT; RH; W	£54.95	12	No	Small and light	Poor
MPS 24	Maino	BC; HI; PT; RH; W	£90.00	24	Yes	Good size and easy to carry	Good from the side
ME 3A	Maino	BC; HI; PT; RH; W	£135.00	50	Yes	Good size and easy to carry	Good from the side

[1] The sources listed are shown by the following codes; details of addresses etc are in section 12.

A Ascott, **BC** Banbury Cross, **BP** Brinsea Products, **DF** The Domestic Fowl Trust, **DH** Dog Health, **GF** Gamekeepa Foods, **GE** Griffin Education; **HI** Hatch-it Incubators, **IL** Insect Lore, **IH** Interhatch, **PH** Philip Harris, **PT** P&T Poultry, **RH** Rob Harvey, **S** Solway Feeders, **W** Wheatcroft.

Table 2 Complete kits

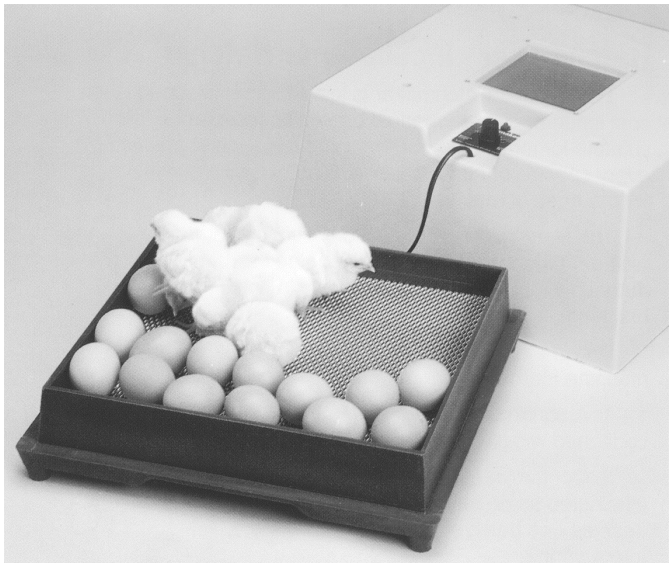
Manufacturer's kit name	Contents of kit	Suppliers (Manufacturer or assembler*)	Order code	Cost inc VAT and delivery unless stated
Beginner's Box	Octagon 10 incubator Egg-lume candling lamp Infra-red brooding lamp Feeding trough (10") 1 litre drinker	Brinsea* Domestic Fowl Trust Hatch-it Incubators Wheatcroft	N102A IN28A None 5000	£159.95 (delivery £7.00) £159 .95 (delivery £4.00) £119.00 (special offer) £135.00 (exc delivery)
Chicken and Egg Box	Polyhatch automatic incubator Egg-lume candling lamp Cosylamp brooder Feeding trough (22") 4 litre drinker Information booklet	Brinsea* Domestic Fowl Trust Hatch-it Incubators[2] P and T Poultry Wheatcroft	N310 A IN26 None None 5002	£359.95 (delivery £7.00) £359.95 (delivery £4.00) £269.00 £269.99 £310.00 (exc delivery)
Complete Home Hatchery Kit	Covatutto 24 semi-automatic incubator Egg-lume candling lamp Humidity meter, Brooder, Feeder, Drinker, Instruction book	Ascott*[3] P and T Poultry	PY285 None	£159.99 £194.99
7 Egg Kit[4]	Covatutto 7 incubator Candling lamp, Incubator book	Interhatch*	E07 EKTM	£54.13 (exc VAT) £63.60 (inc VAT)
16 Egg Kit[4]	Covatutto 16 incubator Candling lamp, Incubator book	Interhatch*	E16 EKTM	£62.81 (exc VAT) £73.80 (inc VAT)
Incubator Classroom Pack	Octagon 20 incubator, Egg lume candling lamp, Wet / dry bulb thermometer, CD-ROM and Lesson plans	Griffin Education	YSM-200-333H	£300.00 (exc VAT)
Octagon 20 Classroom Pack	Octagon 20 incubator, Egg lume candling lamp, Wet / dry bulb thermometer, brooder module, chick enclosure, 1 litre drinker, CD-ROM and Lesson plans	Philip Harris	H71454	£337.00 (exc VAT and delivery)

[2] Hatch-It Incubators also sells kits based on the Maino MPS 12 and 24 models, costing £79.95 and £139.95.

[3] Ascott produces several other kits at greater cost; there is a deluxe version which includes a brooder cage and costs £237.95.

[4] The 7 and 16 egg kits could be used with the Interhatch School Brooder kit, which contains plastic surround, brooder, drinker, feeder, wood shavings and chick food.

Hatchmaker

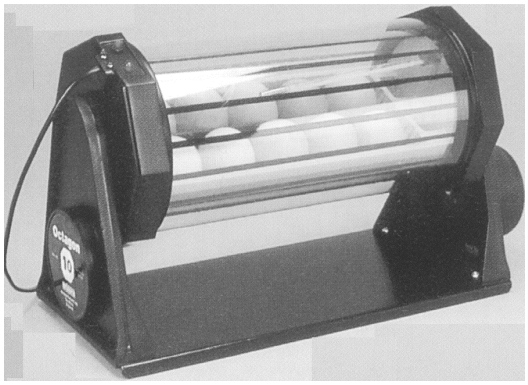


Description:	A still-air incubator, moulded from polyurethane, giving good thermal insulation and finished with a durable, impervious skin which is easily cleaned. Eggs sit on a perforated-metal platform in the base and are warmed by the heating element in the top section. The mercury thermometer is attached to the electronic thermostat and its position can be adjusted so that it is level with the eggs. Temperature readings can be easily taken, looking through the observation window. Humidity is provided by adding water to troughs in the base unit. Ventilation holes pierce the base and cover. Manufactured to BS 3456 and EN 60-335.		
Temperature control:	Recessed, requiring a screwdriver to adjust, within a depression in the top cover. Indicator lamp displays when the heater is operating.		
Capacity:	36 hens' eggs.		
Automatic egg turning:	None.		
Egg / chick observation:	Viewed through a double-glazed acrylic window in cover: only 10.5 x 10.5 cm.		
Mass:	3.5 kg		
Dimensions:	36 x 36 x 20 cm high. Hatched chicks have a *maximum* headroom of 13 cm and less than this if standing on eggs.		
Manufacturer:	Brinsea Products		
Sources:	Ascott	PY 33	£139.45 (inc VAT)
	Banbury Cross		£110.00 (inc VAT)
	Brinsea Products	CH01A	£154.95 (inc VAT)
	Domestic Fowl Trust	IN6	£154.95 (inc VAT)
	Hatch-it Incubators		£127.00 (inc VAT)
	Inter Hatch	E512100	£131.79 (inc VAT)
	P and T Poultry		£125.99 (inc VAT)
	Solway feeders	1126	£149.95 (inc VAT)
	Wheatcroft	0015	£132.95 (inc VAT)

Comments An effective and relatively-inexpensive incubator which, however, is not ideal for schools because of the absence of automatic egg turning and the restricted view of the eggs. For automatic turning, see the *Polyhatch* incubator. The incubator must be opened to add water to the compartments beneath the egg tray. The *Hatchmaker* could also be used along with another incubator, as a 'hatcher', to which eggs are transferred just before the chicks emerge. Easy to clean out.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

Octagon 10



Description: A tiny, still-air incubator, consisting of a clear plastic cylinder, with octagonal end units. An egg tray fits inside the cylinder, with removable plastic dividers to adjust the size of the egg channels. The eggs are gently warmed by heat emitted from 16 black element strips printed onto the plastic cylinder. Eggs are turned manually by just rotating the entire unit, rather than opening it up and moving eggs individually. The mercury thermometer fits into a socket in one end unit and is read through the plastic cylinder. Humidity is provided by adding water to troughs at one end of the egg tray. Ventilation holes pierce one end unit; (natural convective ventilation). Manufactured to BS 3456 and EN 60-335.

Temperature control: An easily-accessible control plus electronic thermostat and indicator lamp display are fitted in one end panel. Fine adjustments are made with a small screwdriver.

Capacity: 10 hens' eggs.

Automatic egg turning: Yes, if a special cradle is used. The incubator is suspended in the cradle which then rocks the eggs from side to side through a 45° angle in each direction. A motor in one end of the cradle slowly turns an arm which moves the incubator continuously through two turns per hour.

Egg / chick observation: Viewed directly through the plastic cylinder. However, the heating strips obscure the view to some extent and, as chicks hatch, a build up of moisture, causing condensation, *may* further reduce visibility.

Mass: 1.0 kg (incubator); 1.0 kg (cradle).

Dimensions: 34 x 15 x 15 cm high. With cradle: 41 x 17 x 23 mm high. Hatched chicks have a *maximum* headroom of 9 cm and less than this if standing on eggs.

Manufacturer: Brinsea Products

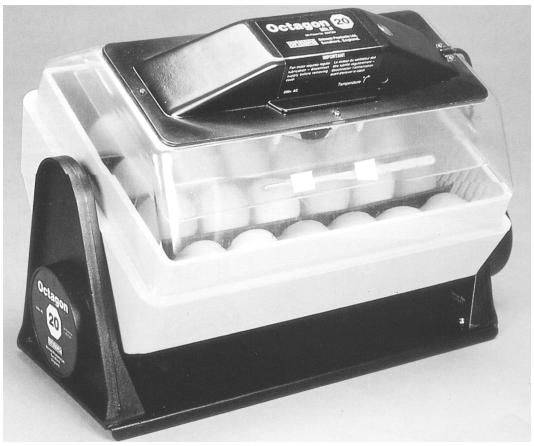
Sources:

	Semi-automatic	(inc VAT)	**Automatic**	(inc VAT)
Ascott	PY30	£83.38	PY30 Auto	£143.95
Banbury Cross		£69.71		£120.86
Brinsea Products	A010IA	£92.65	A011IA	£159.95
Domestic Fowl Trust	IN2A	£92.65	IN2B	£159.95
Gamekeepa Feeds	HI08110	£92.70	HI08C20	£164.70
Griffin	YSM-200-010Y	104.93	YSM-200-030C	£186.59
Philip Harris			A64531	£191.53
Hatch-it		£69.95		£132.00
Insect Lore	288-100	£89.96	+ cradle 288-200	£160.77
Interhatch	E513100	£78.75		
P and T Poultry		£72.99		£124.99
Solway			1133	£155.95
Wheatcroft	0002	£79.95	+ cradle 0006	£138.28

Comments A very small incubator which can provide automatic egg turning at a cost. However, the capacity is very small and the space available for the chicks that hatch is restrictive; the larger *Octagon 20 DX* is better in this respect. The *Octagon 10* could be used along with a *Hatchmaker* employed as a hatching unit. All plastic construction; easy to clean out.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

Octagon 20 DX



Description: This is a compact, forced-air incubator made out of plastic, moulded into an octagonal shape. A base unit contains two troughs for water to provide humidity, above which is an egg tray with movable spacers. A see-through double-glazed top unit gently warms the eggs with heat emitted from 10 black element strips printed onto the plastic. A quiet fan housed on the underside of the top unit circulates air and a slider is used to control air input through ventilation holes. Eggs are turned manually by just rotating the entire unit, rather than opening it up and moving eggs individually. There is a built in digital thermometer.

Temperature control: An easily-accessible control plus electronic thermostat and indicator-lamp display which are fitted in the top unit. Fine adjustments are made with a small screwdriver.

Capacity: 24 hens' eggs.

Automatic egg turning: Yes, if a special cradle is used. The cradle rocks the eggs from side to side through a 45° angle in each direction. A motor in one end of the cradle slowly turns an arm which moves the incubator continuously through two turns per hour.

Egg / chick observation: Viewed directly through the plastic sides of the top cover. However, the heating strips plus the top unit housing the fan somewhat obscure the view and, as chicks hatch, a build up of moisture, causing condensation, *may* further reduce visibility.

Mass: 1.9 kg (incubator); 1.0 kg (cradle).

Dimensions: 33 x 24 x 24 cm high. With cradle: 41 x 24 x 28 mm high. Hatched chicks have a *maximum* headroom of 17 cm but restricted to 12 cm in some places and less than this if standing on eggs.

Manufacturer: Brinsea Products

Sources:

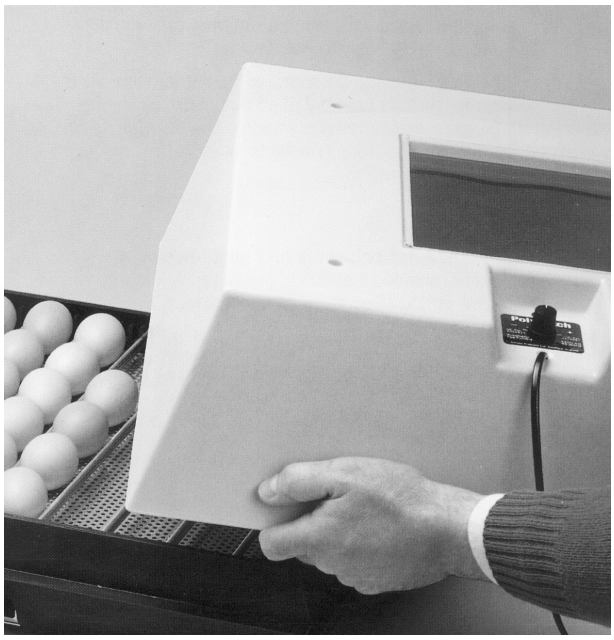
	Semi-automatic	(inc VAT)	**Automatic**	(inc VAT)
Ascott	PY31	£143.95	PY31 Auto	£149.99
Banbury Cross		£116.21		£145.00
Brinsea Products	A024IZA	£159.95	A025IZA	£219.95
Domestic Fowl Trust	IN1A	£159.95	IN1B	£219.95
Gamekeepa Feeds	HI08I20	£160.00	+ cradle HI08C20	£232.00
Griffin			YSM-205-030S	£269.43
Philip Harris			H71442	£251.45
Hatch-it		£120.00		*£139.95
Interhatch	E513200	£135.96		
P and T Poultry				£149.95
Solway	1139	£149.95	1129	£207.95
Wheatcroft	0005	£132.04	+ cradle 0006	£150.00

Comments A similar design to the *Octagon 10* but the larger construction permits a greater capacity and more room for the hatched birds. All plastic construction, so it is easy to clean out. The heating unit can also be fitted on top of a purpose-made plastic enclosure (Brinsea £82.70 inc VAT) to serve as a brooder. A separate unit is also available to monitor and control humidity levels in the *Octagon 20 DX* but this is a *very* expensive item, costing more than the incubator and we would not recommend its use for most purposes in schools.

* Hatch-it Incubators also sells a similar model with a mercury thermometer at £119.99.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

Polyhatch



Description:	A still-air incubator, moulded from polyurethane, giving good thermal insulation and finished with a durable, impervious skin which is easily cleaned. Eggs sit on a movable, perforated-metal platform in the base and are warmed by the heating element in the top section. The mercury thermometer is attached to the electronic thermostat and its position can be adjusted so that it is level with the eggs. Temperature readings can be easily taken, looking through the observation window. Humidity is provided by adding water to troughs in the base unit. Ventilation holes pierce the base and cover.
Temperature control:	Recessed, requiring a screwdriver to adjust, within a depression in the top cover. Indicator lamp displays when the heater is operating.
Capacity:	42 hens' eggs.
Automatic egg turning:	Yes. A movable platform is powered by a small motor and pushes the perforated-metal base tray unit back and forth beneath two metal end units. Metal bars are used to separate the eggs, so these turn as the base plate moves. If very small eggs, such as quail, are incubated, special troughs are required (available from the manufacturer).
Egg / chick observation:	Viewed through a double-glazed acrylic window in cover: 18.5 x 18.5 cm.
Mass:	5.5 kg
Dimensions:	53 x 44 x 23 cm high. Hatched chicks have a *maximum* headroom of 14 cm and less than this if standing on eggs.
Manufacturer:	Brinsea Products

Sources:

Ascott	PY44	Special offer £194.00 (inc VAT)
Banbury Cross		£189.00 (inc VAT)
Brinsea Products	CP01A	£289.95 (inc VAT)
Domestic Fowl Trust	IN4	£289.95 (inc VAT)
Gamekeepa Feeds	HI08I64	£290.00 (inc VAT)
Hatch-it		£189.00 (inc VAT)
Interhatch	E512200	£246.46 (inc VAT)
P and T Poultry		£179.99 (inc VAT)
Solway	1130	£279.94 (inc VAT)
Wheatcroft	0017	£248.19 (inc VAT)

Comments

A similar design to the *Hatchmaker* but with a greater capacity and automatic egg turning, the latter making it a preferable model for schools. The observation window is larger than for the *Hatchmaker* but still provides only restricted viewing. It is important to remember to turn off the automatic turning at the time of hatching; there have been reports of injuries to birds caused by the moving platform. All plastic construction so it is easy to clean out.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

Covatutto 7

Description:	A very small still-air incubator, moulded from polyurethane, giving good thermal insulation. The incubator has a bright-yellow circular base and transparent, plastic, removable dome. Heat is provided by a 15 W 'golf ball' light-bulb heater fixed in a black holder in the centre of the dome. Humidity is provided by adding water to two troughs in the base unit. Small ventilation holes are pierced into the clear dome. The mercury thermometer is inside a plastic case and this slots into a hole in the dome. Eggs are placed on a moulded platform inside the base. The bulb of the thermometer is above the position of the eggs.
Temperature control:	Recessed, requiring a screwdriver to adjust, within a depression in the black lamp holder on top of the clear dome. The heater bulb flashes when the temperature is stabilising.
Capacity:	7 hens' eggs.
Automatic egg turning:	No.
Egg / chick observation:	Viewed through clear plastic dome. View partially obscured by lamp holder.
Mass:	0.95 kg
Dimensions:	Diameter 25 cm, height 24 cm. Hatched chicks have a maximum head height of 7 cm at the centre of the base, 9 cm at the edge. The standing height is reduced if the chicks are standing on eggs.
Manufacturer:	Novital

Sources:

Ascott	PY293	£49.99 (inc VAT)
Dog Health	C7	£59.99 (inc VAT + delivery)
Domestic Fowl Trust	IN12	£59.99 (inc VAT)
Interhatch	E517400	£40.38 (inc VAT + delivery)
P and T Poultry		£48.99 (inc VAT)

Comments

A *very* small incubator. The mercury thermometer is held in position in the clear, rigid plastic, cylindrical case by two springs which fall out if the case is opened quickly. The case has a section which acts as a 'magnifying glass' and this must be positioned over the reading scale of the thermometer. This has a thick red line indicating 100° F and there are two finer red lines, one above and one below this. There is no indication, either on the thermometer or in the instructions, as to the significance of these lines. The temperature is adjusted by turning the recessed screw clockwise (to increase) and anti-clockwise (to decrease), but the extent of the turn needed to produce the required change has to be found by trial and error. The light bulb flashes when the temperature is stabilising and this could be distracting in the classroom.

The all-plastic construction is easy to clean. Advice about this and other aspects of operating the incubator are contained in the detailed instruction book.

There is a red version of this incubator which is available from P and T Poultry; it is cheaper (£39.99, inc VAT) but has a fixed thermometer and is not fully insulated.

A converter plug is required.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

Covatutto 16

Description:	A larger version of the Covatutto 7; it is a still-air incubator, moulded from polyurethane, giving good thermal insulation. The incubator has an opaque, yellow circular base and transparent plastic, removable dome. Heat is provided by a 40 W 'golf ball' light-bulb heater fixed in a black plastic holder in the centre of the dome. Humidity is provided by adding water to two troughs in the base unit. Small ventilation holes are pierced into the clear dome. The mercury thermometer is inside a plastic case and this slots into a hole in the dome. Eggs are placed on a moulded platform inside the base. The bulb of the thermometer is above the position of the eggs.
Temperature control:	Recessed, requiring a screwdriver to adjust, within a depression in the black lamp holder on top of the clear dome. The heater bulb flashes when the temperature is stabilising.
Capacity:	12 - 16 hens' eggs.
Automatic egg turning:	No.
Egg / chick observation:	Viewed through clear plastic dome. View partially obscured by lamp holder.
Mass:	1.7 kg
Dimensions:	Diameter 30 cm, height 30 cm. Hatched chicks have a maximum head height of 12 cm at the centre of the base. The standing height is reduced if the chicks are standing on eggs.
Manufacturer:	Novital

Sources:

Ascott	PY297	£59.99 (inc VAT)
Dog Health	C16	£69.99 (inc VAT + delivery)
Domestic Fowl Trust	IN11	£69.99 (inc VAT)
Interhatch	E517500	£50.57 (inc VAT + delivery)
P and T Poultry		£54.99 (inc VAT)

Comments

The mercury thermometer is held in position in the clear, rigid plastic, cylindrical case by two springs which fall out if the case is opened quickly. The case has a section which acts as a 'magnifying glass' and this must be positioned over the reading scale of the thermometer. This has a thick red line indicating 100° F and there are two finer red lines, one above and one below this. There is no indication, either on the thermometer or in the instructions, as to the significance of these lines. The temperature is adjusted by turning the recessed screw clockwise (to increase) and anti-clockwise (to decrease), but the extent of the turn needed to produce the required change has to be found by trial and error. The light bulb flashes when the temperature is stabilising and this could be distracting in the classroom.

The all-plastic construction is easy to clean. Advice about this and other aspects of operating the incubator are contained in the detailed instruction book. There are two models, one with a red base and the other with a yellow base. The yellow base is fully insulated and the prices above are for this model.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

Covatutto 24

Description:	A box-like incubator, moulded from polyurethane and having good insulation. There is a brightly-coloured base and a clear plastic, removable cover. There is a fan-assisted 75 W element heater in the centre of the cover, a variable temperature control and a fitted mercury thermometer in a plastic case with a magnifying section. There is a removable plastic platform on which the eggs are placed and plastic, removable, egg separators which can be adjusted to take any size of egg. Humidity is controlled by placing water in the basin at the bottom of the incubator.
Temperature control:	Recessed, requiring a screwdriver to adjust, within a depression in the black heating element housing on top of the clear lid. A green warning light flashes when the temperature is stabilising.
Capacity:	20 - 24 hens' eggs.
Automatic egg turning:	'Semi-automatic'. The eggs can be turned from the outside of the incubator by moving a knob connected to the egg tray. This moves the tray sideways and as the separators remain still, the eggs are turned. The eggs are rotated by about 45°. See **Comments** below for details of a fully-automatic turning version.
Egg / chick observation:	The chicks are partially obscured by the fan and heater housing. Maximum headroom for the chicks is 11 cm.
Mass:	3.7 kg
Dimensions:	37 cm x 25 cm x 29 cm
Manufacturer:	Novital

Sources:		
Ascott	PY283	£109.99 (inc VAT)
Dog Health	C24	£134.99 (inc VAT + delivery)
Interhatch	E517550	£108.37 (inc VAT + delivery)
P and T Poultry		£108.99 (inc VAT)

Comments

An easy to use incubator. The mercury thermometer is held in position in the clear, rigid, cylindrical, plastic case by two springs which fall out if the case is opened quickly. The case has a section which acts as a 'magnifying glass' and this must be positioned over the reading scale of the thermometer. This has a thick red line indicating 100° F and there are two finer red lines, one above and one below this. There is no indication, either on the thermometer or in the instructions, as to the significance of these lines. The temperature is adjusted by turning a recessed screw clockwise (to increase) and anti-clockwise (to decrease); the extent of the turn needed to produce the required change has to be found by trial and error. A small green light in the heater housing flashes as the temperature is stabilising. The water container is fiddly to refill.

The all-plastic construction is easy to clean. Advice about this and other aspects of operating the incubator are contained in the detailed instruction book. P and T Poultry imports red and yellow versions; the red is cheaper (£99.95 cf £108.99) but is not fully insulated. A fully-automatic version will be available from P and T Poultry in 2006, costing £138.99 (and possibly also from other suppliers).

A converter plug is required.

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

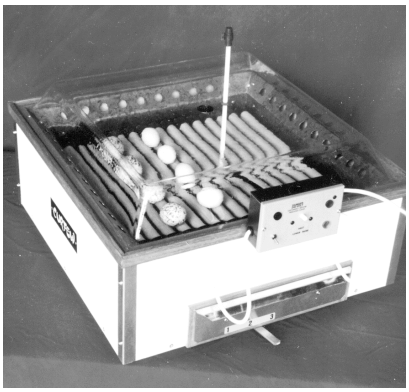
Curfew 136 and 137

These incubators (or earlier versions) were very popular and purchased by many educational establishments in the last 30 years. They may still be in use and / or made available for loan. CLEAPSS made many attempts using all possible means to contact the last-known owner of the company and did obtain one response, indicating in July 2005 that the company would be trading again in about 6 months.

Further attempts to clarify the position have failed and so we can make no comment on the possibility or reliability of supply. We have been informed by one supplier of Curfew incubators in this country (Interhatch) that it has spares for these models and will repair them too.

Model 136

Model 137



Description:	Both the 136 and 137 are still-air incubators, constructed from high-quality, laminated, plywood which has a plastic coating and a frame constructed from mahogany. A domed sheet of 4 mm, high-grade Perspex covers the top of the incubator. Heating elements are situated behind ventilated metal grilles on all four sides of the egg chamber. Humidity is provided by water added to a compartment beneath the egg tray (which can be pulled out for refilling and so avoids opening the incubator). A sheet of hessian is used as a 'wick' over the water tray. Ventilation is controlled by the movement of a lever which adjusts a flap that exposes or covers holes in the base of the incubator.
Temperature control:	An electronic thermostat is situated on the side of both incubators, The temperature sensor is on a flexible arm which passes through the cover and can be adjusted so that its position is at the top of the eggs.
Capacity:	**Model 136** 15 / 20 hens' eggs. **Model 137** Up to 40 hens' eggs.
Automatic egg turning:	**Model 136** No, eggs are placed in the egg tray which has a wire mesh base and should be lined with a sheet of hessian. **Model 137** Yes, a motor moves adjustable rollers which slowly rotate the eggs once each hour. For hatching, the rollers can be removed and eggs transferred to the egg tray below. This has a wire-mesh base and should be lined with a sheet of hessian. Automatic turning can be switched off to allow movement of the eggs by hand during the day. It is possible to have in the incubator at the same time eggs that were set on different days; while some eggs are turned on the rollers, others can be hatched in the space beneath.
Egg / chick observation:	Viewed through the Perspex cover, giving a completely unobstructed view.
Mass:	**Model 136** 7 kg **Model 137** 11 kg
Dimensions:	**Model 136** 39 x 36 x 20 cm high. Hatched chicks have a maximum headroom of 16 cm but less than this if standing on eggs. **Model 137** 50 x 50 x 27 cm high. Hatched chicks have a maximum headroom of 16 cm but less than this if standing on eggs.
Manufacturer:	Curfew Incubators
Source:	Curfew Incubators (but see comments above)
Comments	Both are sturdy, reliable incubators, with provision for the observation of eggs and chicks that is excellent. The absence of automatic egg turning in 136 makes this a less-attractive incubator for schools than the 137 model. The incubator is heavier than others but still portable. Curfew models are more difficult to clean out than other incubators.

MPS 12

Description:	A small, moving-air incubator, moulded from polyurethane and shaped like a 'squashed oval'; it has a coloured, opaque base and a removable, translucent domed lid. Visibility is poor. The eggs are warmed by the heating element in the lid. Eggs are put into the coloured base; there is neither rack nor dividers, and the eggs are turned by hand. There is a small, loose, plastic container for water and this provides humidity. There is a fan near the heater and both are protected by a wire mesh cage. The thermometer reads 10 to 50° C, and there is a red line at 38° C. The thermometer fits in a hole in the lid and the bulb rests on the wire cage inside the lid. There is a thermostat; temperature adjustment is by a small, easily-accessible screw on the lid, There is a red warning light. The lid also has one ventilation hole.
Temperature control:	The screw on the lid is turned by hand (clockwise to increase and anti-clockwise to decrease). You do not need a screwdriver. The heater light flashes when the temperature is stabilising.
Capacity:	12 hens' eggs.
Automatic egg turning:	No.
Egg / chick observation:	Viewed through translucent dome but obscured by the cage surrounding the heater and fan as well as the translucent plastic.
Mass:	1.4 kg
Dimensions:	37 x 25 x 20 cm. Hatched chicks have a maximum head height of 10 cm at the sides of the base. The standing height is reduced if the chicks are standing on eggs.
Manufacturer:	Maino Enrico - Adriano (Italy)
Sources:	Banbury Cross — £54.95 (inc VAT) Rob Harvey — £57.99 (inc VAT + delivery) Hatch-it Incubators — £59.95 (inc VAT) P and T Poultry — £59.99 (inc VAT) Wheatcroft 0021 — £55.00 (inc VAT)
Comments	A small incubator that is easy to clean and store. It comes with an instruction sheet which is translated from the Italian into quaint English! To turn the eggs and replenish the water, you have to take off the lid and so the humidity and the temperature will fluctuate. Eggs may hit each other if the incubator is lifted or moved carelessly. The translucent lid is to be replaced with a transparent one, but the importer could not give a date for the change when asked in 2005.

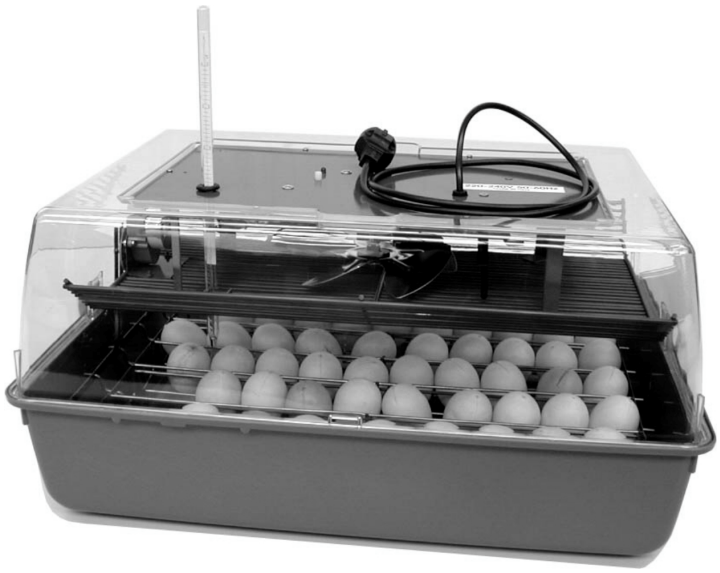
All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

MPS 24

Description:	A small, box-like, moving-air incubator, moulded from polyurethane; it has a coloured, opaque or transparent base which is fitted with a wire mesh lining. There is a removable, transparent domed lid, which is kept in place by one retention screw on each side of the base. The eggs are heated by the heating element in the lid. There is a fan near the heater and both are protected by a wire mesh cage Eggs are put into a metal frame with six horizontal rows; this frame has a vertical arm which fits into a rod that projects from a slowly-rotating disc near the heater. Fixing the two together is easy. This rod and frame arm comprise the automatic-turning device. There is a trough fixed to one side of the base for water. The thermometer reads 25 - 45° C, and there is a red line at 38° C. The thermometer fits in a hole in the lid; there is a rubber band around the thermometer and this should be positioned so that it prevents the thermometer falling through the hole. There is a thermostat; temperature adjustment is by a small, easily-accessible screw on the lid. There is a red warning light. The lid also has one ventilation hole.		
Temperature control:	The screw on the lid is turned by hand (clockwise to increase and anti-clockwise to decrease). You do not need a screwdriver. The heater light flashes when the temperature is stabilising.		
Capacity:	24 hens' eggs.		
Automatic egg turning:	Yes.		
Egg / chick observation:	Viewed through the transparent base and lid; slightly obscured by the cage surrounding the heater and fan.		
Mass:	2.7 kg		
Dimensions:	41 x 30 x 20 cm. Hatched chicks have a maximum head height of 17 cm at the sides of the base. The standing height is reduced to about 10 cm if they are standing beneath the heater cage.		
Manufacturer:	Maino Enrico - Adriano (Italy)		
Sources:	Banbury Cross		£114.00 (inc VAT)
	Rob Harvey		£119.99 (inc VAT + delivery)
	Hatch-it Incubators		£90.00 (inc VAT)
	P and T Poultry		£104.99 (inc VAT)
	Wheatcroft	0032	£115.00 (inc VAT)
Comments	A good incubator for school use. It is easy to clean and store. It comes with an instruction sheet which is translated from the Italian into a quaint English! To replenish the water, you have to take off the lid, but as this will be for a very short time, fluctuation in humidity and temperature will be slight. It provides good views of hatching chicks. The importer says that this model can also be used as a brooder once all the eggs are hatched because the temperature can be reduced to one appropriate for that purpose.		

All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

ME 3A



Description:	A rectangular, moving-air incubator, moulded from polyurethane; it has a coloured, opaque base with an aluminium grid inside and a removable, transparent lid, which is kept in place by two plastic clips. The eggs are warmed by the heating element in the lid. Eggs are put into 'rocking' rows in a frame in the base. This has a projecting 2-pronged arm, into which slots the short rod on the slowly-rotating disc, which is the turning device. Fitting these together is easy. Luke-warm water is put into the base up to the level of the aluminium grid and then covered with the plastic sheets provided. There is a fan near the heater and both are protected by a wire mesh cage. The thermometer reads 25 to 45° C, and there is a red line at 38° C. The thermometer fits in a hole in the lid and the bulb rests on the wire cage inside the lid. There is a thermostat; temperature adjustment is by a small, easily-accessible screw on the lid. There is a red warning light. The lid also has one ventilation hole.
Temperature control:	The screw on the lid is turned by hand (clockwise to increase and anti-clockwise to decrease). You do not need a screwdriver. Heater light flashes when the temperature is stabilising.
Capacity:	50 hens' eggs.
Automatic egg turning:	Yes.
Egg / chick observation:	Good. Viewed through the transparent lid; best at the sides.
Mass:	5.65 kg
Dimensions:	57 x 40 x 29 cm. The head height of hatched chicks is variable, depending on where the chicks are in the incubator. It varies between 8 and 12 cm. The standing height is reduced if the chicks are standing on eggs in the turning frame.
Manufacturer:	Maino Enrico - Adriano (Italy)

Sources:			
	Banbury Cross		£135.00 (inc VAT)
	Rob Harvey		£149.99 (inc VAT + delivery)
	Hatch-it Incubators		£139.95 (inc VAT)
	P and T Poultry		£149.99 (inc VAT)
	Wheatcroft	0022	£135.00 (inc VAT)

Comments A larger incubator than the MPS 24 but it is just as easy to clean and store. It comes with an instruction sheet which is translated from the Italian into quaint English! To replenish the water, you have to take off the lid and so the humidity and the temperature will fluctuate. The importer says that this model can also be used as a brooder once all the eggs are hatched because the temperature can be reduced to one appropriate for that purpose. The plastic sheets that are placed over the aluminium frame to help regulate humidity may easily be lost as they could be mistaken for packing material. However, the importer claims the regulatory process is not affected if they are missing!

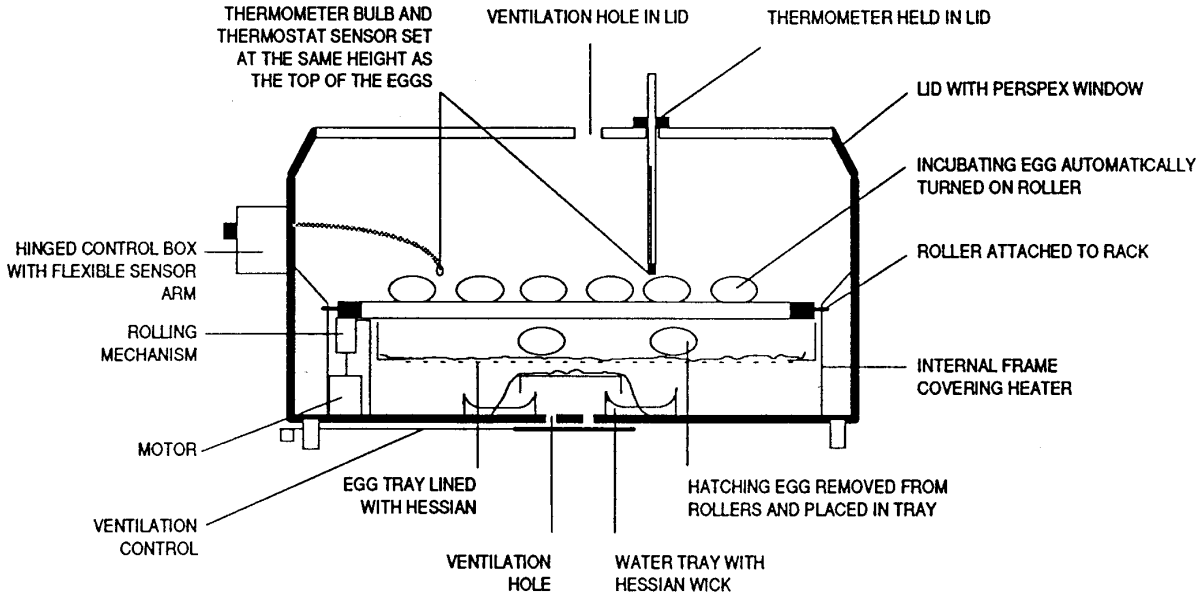
All the suppliers will accept orders on official school order forms. Please see note about delivery costs in section 4.2.

5. INCUBATING EGGS

5.1 Setting up an incubator

Whichever model of incubator you have available, ***it is vital to refer to the manufacturer's instructions*** supplied with it. These have been written to give the best results with that particular model and some aspects may not be applicable when using other incubators. For this reason, it is not easy to provide detailed guidance here which will be appropriate for work with all types of incubator. **These notes, therefore, should be regarded as general guidance only**. The illustration below represents the popular *Curfew 137* incubator; although other models have a different construction, they share many of the basic features.

Figure 2 Features of an egg incubator



SITING THE INCUBATOR

Place the incubator on a level surface in a position which is not prone to vast fluctuations in temperature and humidity, ie, out of draughts, direct sunlight and away from central-heating radiators. Be warned that in winter, schools often become very cold at night once the heating is off. If the temperature drop is too great, it is quite likely that the incubator will be unable to maintain a steady temperature. It is therefore best to avoid incubating eggs during the coldest months if temperature regulation is likely to be a problem. Although an incubator might be taken home every night, this is highly inconvenient. Also, mechanical damage to the developing embryos caused by bumping the incubator in transit may cause severe damage to delicate membranes and organs, and so the regular movement of an incubator is ***not*** recommended.

SETTING UP IN ADVANCE

The first task is to clean and disinfect[3] the incubator, as appropriate. The incubator should be set up at least 48 hours before eggs are introduced to enable the correct temperature and humidity to be established and to check on the normal functioning of the thermostat. Some manufacturers give specific instructions about cleaning their particular models and these should be followed.

[3] The most appropriate disinfectant to use is probably *ASAB* from Griffin (GASAB; 1 litre £21.14) but this is obviously expensive and only available in large volumes. Another disinfectant, *Virkon*, could be used (though it does attack metal) and this is available from Philip Harris in 50 g sachets (A58543; £1.91) or, more economically, in 500 g tubs (A58555; £16.48). Local pet shops may also sell *VirKon*. Several of the suppliers of incubators sell suitable disinfectants and this could be purchased when ordering other items.

ESTABLISHING THE CORRECT TEMPERATURE

The correct temperature for the incubation of a ***chicken's*** egg is 37.5 °C at the ***centre*** of the egg. **Follow the manufacturer's instructions about setting the temperature.** In some still-air incubators, there is quite a large temperature gradient inside. With some models in which the thermometer is situated at the top where the air is warmer, the recommended temperature setting may ***appear*** to be too high. However, such a setting allows for the cooler, correct, incubation temperature lower down.

INCUBATION TEMPERATURE OF 38 - 39.5 °C

In most incubators, the thermometer should be positioned where the top of the eggs will be. Manufacturers' recommended temperature settings could therefore lie anywhere between 38 °C and 39.5 °C (100.5 - 103 °F). In normal incubator operation, temperatures may fluctuate slightly but they should not be allowed to pass outside this range. As the eggs develop, the embryos will give off some heat and this *may* require you to alter the thermostat setting *slightly* to decrease the temperature. Some instruction books (eg, those provided by Novital for *Covatutto* models) give temperatures only in degrees Fahrenheit.

For incubation temperatures of the eggs of species other than chickens, refer to the information **in section 5.4**.

AVOIDING PUPIL INTERFERENCE

Once the correct temperature setting for the type of eggs to be incubated has been achieved, it is wise to tape over the temperature control to dissuade pupils 'tweaking' the knob! If possible, position the incubator so that the temperature control is hidden against a wall.

GUARDING AGAINST POWER FAILURE OR DISCONNECTION

Consider plugging the incubator into an audible alarm unit[4]; this will indicate if there is a power failure for any reason. Even with such a device, it is a good idea to affix a '**PLEASE LEAVE ON**' sign to the mains plug and so avoid accidental switching off by cleaners or other members of staff. It is also sensible to keep a temperature record card, logging readings every morning and evening. This is an easy way of checking that the incubator is functioning correctly and the card could also be used for a record of egg turning, if this is being done by hand.

ENSURING ADEQUATE HUMIDITY

A suitable humidity must be maintained to prevent the eggs drying out too quickly as well as ensuring they lose sufficient water. All incubators have one or more water containers, trays or troughs which should be kept topped up with water to maintain an appropriate humidity, *according to the manufacturer's instructions*. Use hand-hot (39 °C) water to prevent the temperature in the incubator dropping too dramatically when refilled. Do not move the incubator while containing water. In some incubators, a piece of cloth may be needed to act as a 'wick'.

Too much humidity at the wrong time is just as bad for a developing egg as too dry an atmosphere: an egg ***must*** lose a certain amount of water during incubation if the chick is to emerge satisfactorily. **See section 5.2** for more information.

WET-BULB THERMOMETERS FOR HUMIDITY: ***VERY INACCURATE***

Some incubators are supplied with a wet and dry-bulb thermometer. The wet bulb is for obtaining readings of humidity. However, it is ***very*** difficult to obtain accurate readings with such a device and we would not recommend that they are used. If used, *no reliance should be placed on readings obtained*. It is better to check humidity by assessing the effects on the egg, as described later, rather than to obtain actual measurements.

ELECTRONIC INSTUMENTS

Relatively accurate electronic instruments for measuring humidity (called hygrometers) are now available but the most useful of these are quite expensive. A pocket-sized, combined temperature and humidity measurer (code AHT-305) is available from ATP Instrumentation at £29.95 (exc VAT) which could be placed inside an incubator but this could be too large for the smallest models. If schools would like details of such equipment, they should contact the CLEAPSS ***Helpline.*** Manufacturers also supply units which will control the humidity in certain of their incubators. These are, however, more costly than the incubators themselves and so we have chosen not to consider them here.

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[4] These may be available locally as freezer alarm *plugs* or special units can be purchased from egg incubator suppliers. Brinsea Products has an audible alarm (ETVO 20A at £164 95 inc VAT, exc delivery). Hatch–it Incubators supplies a temperature alarm module (T20) at £136.00.

ENSURING ADEQUATE VENTILATION

The eggs must have a suitable flow of air to supply enough oxygen for the embryos to develop and to remove the carbon dioxide produced. The ventilation will, however, also affect both the humidity and the temperature; a high ventilation rate will carry more moist, warm air out of the incubator. A fine balance of all three inter-related factors has to be achieved and this will need to be altered at different times during incubation.

Care should be taken to set the ventilation control according to the manufacturer's instructions. These may advise particular settings for different room temperatures. For example, in a cool room (below 16 °C), a minimum level of ventilation should be sufficient; with room temperatures above 16 °C, more ventilation should normally be provided. On some incubators, a flap covering ventilation holes may need to be moved; in others, the number of holes that are left open may need to be altered.

ENSURE THAT VENTILATION HOLES ARE NOT COVERED

Frequent checks should be made to ensure that nothing is preventing adequate ventilation. **Refer to section 5.2** for more information on regulating ventilation.

5.2 Incubating chicken eggs

PRE-WARMING EGGS PRIOR TO INCUBATION

First, allow the fertile eggs to warm up to room temperature for at least 12 hours before placing them into the incubator. Cool eggs may lower the temperature of the incubator or be stressed if they are warmed up too quickly.

LINING EGG TRAYS WITH HESSIAN

In the old, but popular, *Curfew* incubators, as shown in Figure 2, whenever eggs are to be placed into an egg tray, it is important to line the tray first with a piece of ***loose-weave*** material such as hessian or a dishcloth. (Hessian should be provided with new incubators; spares may be available from Curfew Incubators or other suppliers.) Since the tray has a metal mesh, this can become hot, so it is essential that all the eggs are on the cloth inside the tray (and also are not touching the vertical sides of the tray, if these are also made of metal). The material must ***not*** be moistened with water.

DO NOT SET EGGS ON A MONDAY

If all goes to plan, the chicks should hatch after 21 days, so do not set the eggs on a Monday or they will hatch out at the weekend. Do not start to incubate the eggs before a holiday period or there may be difficulties in caring for the adults or observing the chicks for the desired period.

TURNING THE EGGS EACH DAY

Turning helps to prevent the developing membranes from sticking to the inside of the shell. If it is not possible for the eggs to be turned regularly including at weekends, schools must accept that embryos will often be damaged and a much lower success rate at hatching, even zero, may be experienced. Eggs may be turned by hand, either because the incubator has no automatic turn facility or because pupils will do this during the day, while the incubator turns the eggs at night and at weekends. Manual turning of eggs needs to be carried out at least twice, preferably three times and, ideally, five times a day, *including at weekends*. If the incubator has an automatic turn facility, this relieves schools of the problem.

MANUAL TURNING: MARK THE EGGS WITH AN 'X' AND AN 'O'

For non-automatic incubators, other than the Brinsea *Octagon* types, mark each egg lightly with an 'X' *in pencil* on one side and 'O' on the opposite side as the eggs are added to the incubator. Also write the date if different batches of eggs will be added to the incubator later.

The degree of turn varies from 45° through 180° around their long axis, not end to end. At each turn, move the eggs so that the 'X' and 'O' marks are alternately visible. Turning is best achieved by ***rolling*** each egg, using the finger tips, into an adjacent space. If the incubator is very crowded, it may be necessary to remove some eggs at one end so the other eggs can be rolled into the space made available. The removed eggs are then placed in the space created after rolling. Hands should be warm to prevent chilling the eggs.

OCTAGON INCUBATORS: TURN EGGS BY MOVING THE ENTIRE INCUBATOR

With *Octagon* incubators, eggs can be turned without opening the incubator by tipping the entire unit from 45° on one side to 45° on the other side. However, do not worry about opening the incubator for a short time to turn eggs. Although the temperature will temporarily drop, the developing chicks will not be harmed; after all, a broody hen does not sit on the eggs *all* the time!

TURN EGGS AN ODD NUMBER OF TIMES

Some authorities claim that eggs should sometimes be turned clockwise and then counter-clockwise. If eggs in a manual-turn incubator are turned an odd number of times each day, they will not repeatedly spend each long, night-time period in the same orientation.

STOP TURNING EGGS ON DAY 18

By the 18th day, the eggs no longer need to be turned.

ADJUSTING THE HUMIDITY LEVEL

Follow the guidance offered by the incubator manufacturer. Various authorities quote a wide range of suitable humidities but it is difficult to produce an exact humidity in the incubator and to measure it accurately. Ensure, however, that the water tray never dries out completely and equally do not have a very humid atmosphere together with poor ventilation. If the eggs are in an egg tray on a dish cloth or piece of hessian, do ***not*** add water to the material to make it damp. Also do ***not*** spray the eggs daily with a mist of water, although this has been recommended by some authorities.

Humidity levels should ideally be varied during incubation but it is difficult to give precise advice. As a general rule, during the first half of the incubation period, the humidity should be at a low to medium level; the second half requires a medium level of humidity. Some authorities recommend a dryer atmosphere around day 18 to help the chick break into the air space. As soon as the eggs become 'pipped', with the chick starting to break out of the shell, the humidity should be raised to a high level for hatching.

MONITORING LOSS OF MOISTURE FROM THE EGGS

It is ***essential*** that the eggs lose about 12 - 15% of their mass over the incubation period. Humidity that is too high or too low will cause too little or too much mass to be lost. Water loss can be monitored by measuring loss in mass (by weighing the eggs) or by observing the size of the air space - using a technique called 'candling' (**see section 5.3**). Measuring the loss of mass is probably the better technique to use but is more troublesome to carry out and requires a reasonably accurate balance. Candling requires some skill.

WEIGHING EGGS REGULARLY

By removing a batch of eggs and weighing them at regular intervals, the loss in mass can be monitored and adjustments to humidity made as appropriate. (It is better to measure the mass of several eggs and calculate an average loss per egg because the balance available is probably unlikely to be sufficiently accurate for small masses.) Ensure that the eggs are not excessively chilled when they are being weighed; measurements should be carried out quickly.

Figure 3 overleaf shows the expected loss of mass as incubation progresses. The loss should ideally fall on the solid line but some oscillation on either side of the line will not harm the embryo, providing it is not too great. If there is too little loss of mass, ventilation should be increased (and / or humidity decreased). If there is too much loss, the ventilation is too high and should be reduced (and / or humidity increased).

5.3 Checking development by candling

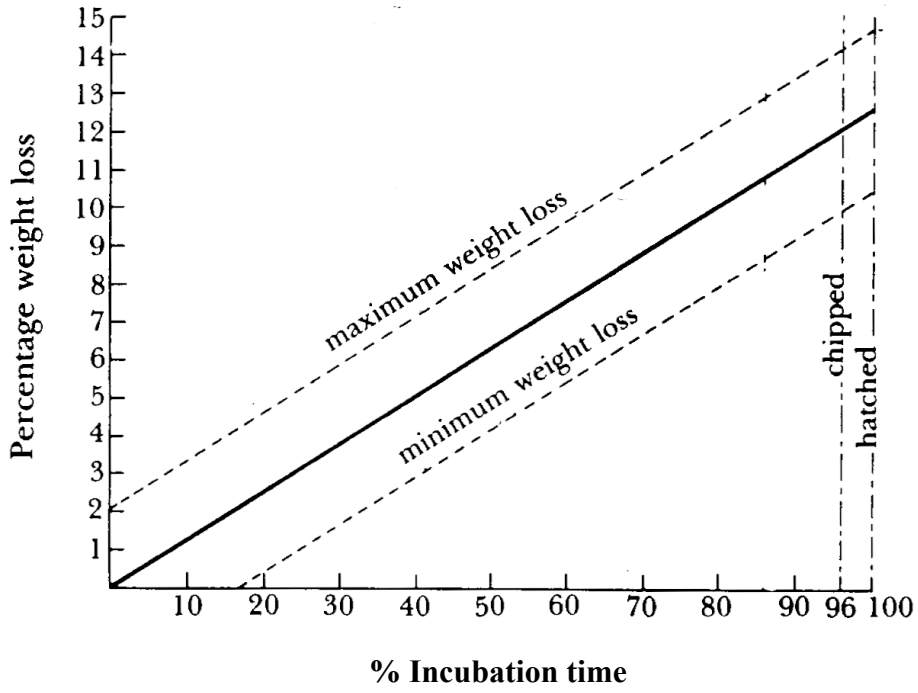
VIEWING THE EGG AGAINST A BRIGHT LIGHT

Candling involves holding the egg in front of a bright light in a darkened room so that the light shines through the shell. A simple way to do this is to cut a 4 cm hole in a piece of card and hold this over the bright light with the egg in front of the hole. However there are ready-made devices called candling or egg-lume lamps.

COMMERCIAL 'CANDLERS'

All of the incubator manufacturers and suppliers listed in Table 1 sell egg-lume candling lamps, which consist of a lamp in a hand-held holder with viewing 'window' and push-button operation. Prices start at £7.83 for the Interhatch model (E240) to £24.95 (inc VAT) for the standard model from Brinsea Products (F150A).

Figure 3 Graph of ideal loss of moisture from incubating eggs



COMMERCIAL 'CANDLERS' continued

There are also high-intensity versions; these have a tungsten-halogen bulb that operates at low voltage and is likely to be more robust with a longer life (a transformer is built into the plug). None of the egg-lume lamps has, however, been evaluated by CLEAPSS for electrical safety.

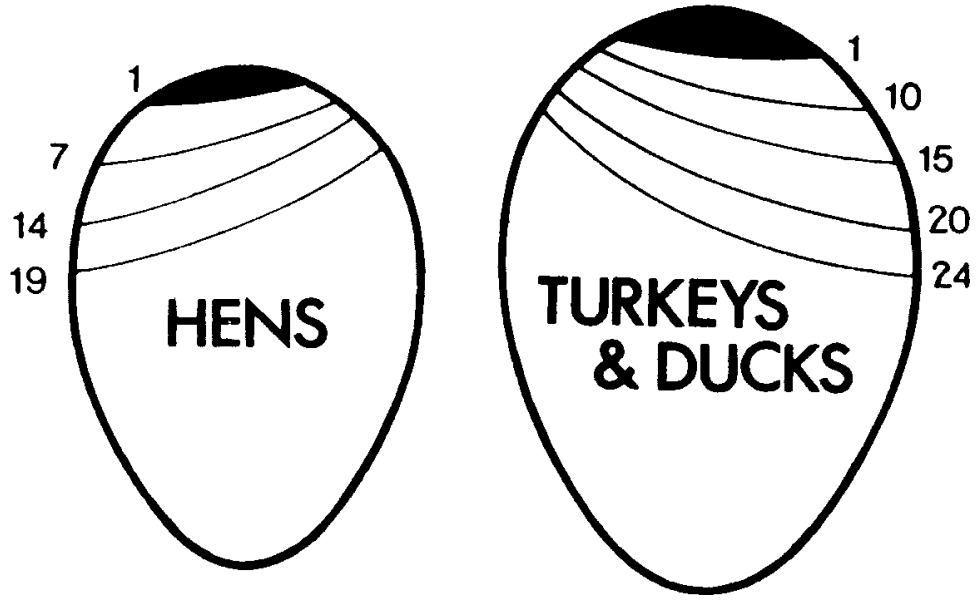
THE EARLY EMBRYO SHOWS UP AS A DARK SPOT

At early stages, the embryo will be seen as a dark spot, perhaps also showing the blood vessels radiating outwards. A completely clear egg is infertile. As the egg develops, the air space at the broad end becomes larger as moisture evaporates from the egg. As the embryo becomes larger, little light will pass through the egg except to show the air space.

CANDLING REVEALS THE SIZE OF THE AIR SPACE

Figure 4 shows the expected size of the air space of hens' eggs (and also turkeys & ducks for comparison) at the start of incubation (1) and on specified days, ***if humidity levels have been correct***. Candling of hens' eggs is therefore recommended on the 7th and 14th days of incubation.

Figure 4 Changes in size of air space during days of incubation



AIR SPACE SIZE SHOWS IF CORRECT CONDITIONS OF INCUBATION HAVE BEEN ACHIEVED

If it becomes apparent that the air space is too small or too large for the stage of development reached, there will have been, respectively, too little or too much evaporation of water from the egg. If the air space is too small, ventilation should be increased (and / or humidity decreased). If the air space is too large, the ventilation is too high and should be reduced (and / or humidity increased).

Candling should be performed as quickly as possible to avoid excessive chilling of the eggs. If candling reveals that eggs are infertile or the chicks have died, the eggs should be removed from the incubator.

5.4 Incubating the eggs of birds other than chickens

A variety of birds other than chickens can be incubated and hatched if supplies of their fertile eggs become available. These include bantams, ducks, geese, guinea fowl, pea fowl, pheasants, quail and turkeys. (Note that only eggs of *domesticated* species are to be studied.) For sources of supply, **see section 3**. We do not, however, recommend that any of the above should be chosen by schools *new to incubation*; experience should first be gained with hens' eggs.

IDENTIFYING INCUBATION TEMPERATURES AND PERIODS

The technique of incubation described for chickens is essentially the same for other eggs. Obtaining reliable figures for incubation times and temperatures applicable for different birds is not all that easy. Different incubation periods and temperatures are quoted by different authorities and, as discussed on page 23, the design of the incubator will also influence the required thermostat setting.

For some birds, such as ducks and quail, there are several different varieties or species for which eggs may become available and so, again, different temperatures and incubation times may be quoted.

It is therefore important to ask the supplier of the eggs for the recommended incubation temperature and suggested incubation period and any other 'tips' on successful hatching. Also check with the incubator manufacturer, if details of the necessary conditions are not given in the accompanying instructions. Nevertheless an attempt is made below to offer some general advice for different birds and a summary of recommendations is given in Table 3 overleaf.

INCUBATOR CAPACITIES FOR EGGS OF VARIOUS BIRDS

Most manufacturers indicate the capacity of their incubators in terms of numbers of chicken eggs. To find the approximate number of eggs of other birds that can be accommodated, refer to Table 3 and multiply the stated capacity by the conversion factor.

TIPS FOR SUCCESSFUL INCUBATION WITH VARIOUS SPECIES

Several authorities suggest that duck and probably goose eggs require a slightly lower incubation temperature than the eggs of chickens, while the eggs of guinea fowl, pheasants and quail should have a slightly higher incubation temperature. For turkeys, some suggest that the temperature should be increased by about 0.5 °C each week, starting at 38 °C and ending up at 39.4 °C for the last week.

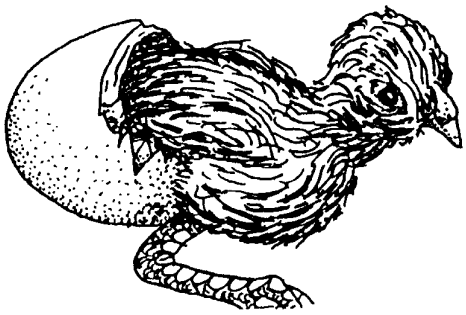
Some sources state that the eggs of ducks, geese and turkeys should receive regular spraying, or even soaking, with warm water during incubation, (followed by a drying-out period just before birds start to emerge). This can be dangerous if overdone and insufficient moisture is lost as a result. It is better to raise moisture levels in the incubator a little and assess whether the correct humidity has been achieved by candling (**see page 25**) and then make any necessary adjustments. Turkey, duck and goose eggs may benefit from being sprayed with warm water after the shell has been broken (pipping) and the young bird is struggling free. Pheasant eggs **must** have a very high humidity after pipping.

In all cases, turning of eggs should be stopped around 3 - 4 days before hatching is expected.

Table 3 Incubation data for various birds other than chickens

Bird	Incubation time (days)	Temperature	Egg size conversion factor
Bantams	19 - 21	38 - 39°C (100.5 - 102°F)	1.20
Ducks	28 - 35	38 - 39°C (100.5 - 102°F)	0.75
Geese	28 - 32	38 - 39°C (100.5 - 102°F)	0.40
Guinea Fowl	28	38 - 39.5°C (100.5 - 103°F)	1.70
Pea Fowl	28	38 - 39°C (100.5 - 102°F)	0.60
Pheasants	24	38 - 39.5°C (100.5 - 103°F)	1.50
Quail	16 - 23	38 - 39.5°C (100.5 - 103°F)	2.50
Turkeys	28	38 - 39°C (100.5 - 102°F)	0.60

6. HATCHING EGGS and REARING THE CHICKS TO ADULTS



STOP TURNING EGGS ON DAY 18

Towards the end of the incubation period, after day 18, the eggs no longer need to be turned as the chicks have largely completed their external development and the animal is manoeuvring itself into the correct position to make the initial break in the egg shell (the process called 'pipping'). Ensure that ventilation is adequate, as there is a real risk that the chicks can be suffocated by a build up of carbon dioxide at this critical time.

INCREASE HUMIDITY FOR HATCHING

Ideally, the air in the incubator should be drier on day 18, to help the chicks break through the egg membranes into the air space. As soon as eggs are pipped, however, a high humidity is needed to stop exposed membranes from drying out, becoming tough and leathery and preventing normal hatching. In many situations, however, all eggs will not pip at the same time and so it will be impossible to provide the best conditions for both pipping and hatching. This is when a *second* incubator, used as a hatcher, is ideal; eggs are transferred in batches as they become pipped. Without a separate hatcher, wait until about a third of the eggs have pipped and then increase humidity. At this stage, do not keep opening the incubator to check on progress as this will allow the moist air to escape which takes some time to build up again.

6.1 The chicks hatch

ALLOW HATCHING TO OCCUR AT ITS NATURAL RATE. **DO NOT** INTERFERE UNNECESSARILY

On day 21, though there is often some variation in development rate, the chicks should begin to hatch. There can be a period of several hours between the first hole being made in the shell and final emergence. Only intervene if it appears that a chick has become stuck for a period of 24 hours or more. Then it may be helpful to enlarge, very carefully, the hole with forceps or scissors. Keep the points of the instruments parallel to the shell and *not* inserted inwards or the chick may be damaged.

HATCHING TIME IN OTHER SPECIES

Hatching can take a long time in other species; duck and turkey eggs for example can take between 36 hours and 3 days. If these species are being kept, it is important not to become impatient and help the birds along! This longer hatching time can be useful as it ensures that all children will have an opportunity to observe the hatching process, something that can be missed with the eggs of chickens when it occurs during the night.

ALLOW NEWLY-HATCHED CHICKS TO REST; THEN MOVE THEM TO A BROODER

When the chick emerges it will be wet, often blood stained and very weak. It will need at least 12 hours to dry out and it will be some time before it can stand without falling over. It should be left in the incubator or hatcher for this period and then removed to a brooder as described **in section 6.2**. There may be insufficient oxygen in an incubator for many chicks to breathe and an incubator is an unsuitable enclosure in which to feed and water the young animals.

PROBLEMS OF AN EXPOSED YOLK SAC

The yolk sac attached to the developing embryo inside the egg (see Figure 13 in section 10) is normally absorbed during the final days of incubation. Occasionally a chick may hatch with its yolk sac hanging out. Its survival is endangered and the chick should be isolated. The yolk sac may naturally be reabsorbed but this takes time and the chick must be kept in clean conditions to help prevent infection. If, given time, reabsorption does not happen or the chick is obviously in distress, it should be humanely destroyed as should any chicks with other deformities or evident illness; see information in section 8. Any animal which is isolated and later returned to the brooder may be attacked by other chicks. It is best if the animal is reintroduced at a time when food is given to all the chicks so that attention is diverted away from the newcomer.

STORAGE OF WASTES IN THE ALLANTOIS: REMAINS OF THIS MAY BE SEEN AT HATCHING

A feature of the development of the chick is the formation of an external pouch and membranes called the ***allantois***. Waste materials are deposited in this structure. The remains of the allantois and its wastes are sometimes seen still attached to the rear end of the hatched chick. This is not something to worry about. The remains will dry up and drop off.

DO NOT DISPOSE OF UNHATCHED EGGS TOO QUICKLY!

Even with eggs set on the same day, there can be quite a lot of variation in the time they take to hatch and so it is important to wait at least 72 hours before discarding unhatched eggs. The remains from hatched eggs should be removed from the incubator as soon as possible and these, together with unhatched eggs, should be disposed off hygienically (**see section 9**). The incubator should then be thoroughly cleaned out and disinfected (see information in the footnote on page 22).

6.2 Using a brooder

CONSIDER THE SITING OF THE BROODER

An incubator should ***not*** be used to house chicks, once they have hatched, rested and their feathers dried out. A simple **brooder** needs to be bought or constructed to house the chicks and keep them warm; because of their small size, chicks have a relatively-large surface area from which to lose heat. A brooder is some form of enclosure with an overhead heat source.

The brooder must be sited ***away from draughts*** and placed on a large sheet of paper, preferably *not* newspaper. Some authorities suggest that the floor of the brooder should then be covered with a layer of good-quality white wood shavings (not sawdust), available from pet shops or, more economically, in large bales from specialist suppliers (see *Yellow Pages* under "Sawdust and Shavings"). This, however, is not essential and does add to the mess that must routinely be cleared up.

Chicks suffer from cramp if kept on a cold surface. Ideally they should be reared off the floor, on a wooden surface. Wherever the brooder is placed, it is prudent to protect the surface by covering it with polythene.

It may be necessary to cover the brooder with wire netting at some stage to prevent the birds escaping. A fire safety guard for children has proved useful here.

USING A PURCHASED BROODER

A purpose-built brooder called the *Cosy lamp* is available (see Figure 5 overleaf). This has passed CLEAPSS electrical tests and is manufactured and supplied by Brinsea Products (HA02A £79.95 inc VAT) and also sold by several other suppliers, including Interhatch.

The brooder uses ordinary lamp bulbs, operating at reduced voltage, to provide a source of heat; the casing does not become too hot. The base area of the unit measures 500 mm × 500 mm and it stands directly on the floor or table top, though it could be suspended for brooding birds much larger than chicks, such as goslings. The chicks can walk out through an entrance hole, so it will be necessary to provide an outer perimeter barrier to prevent the animals straying.

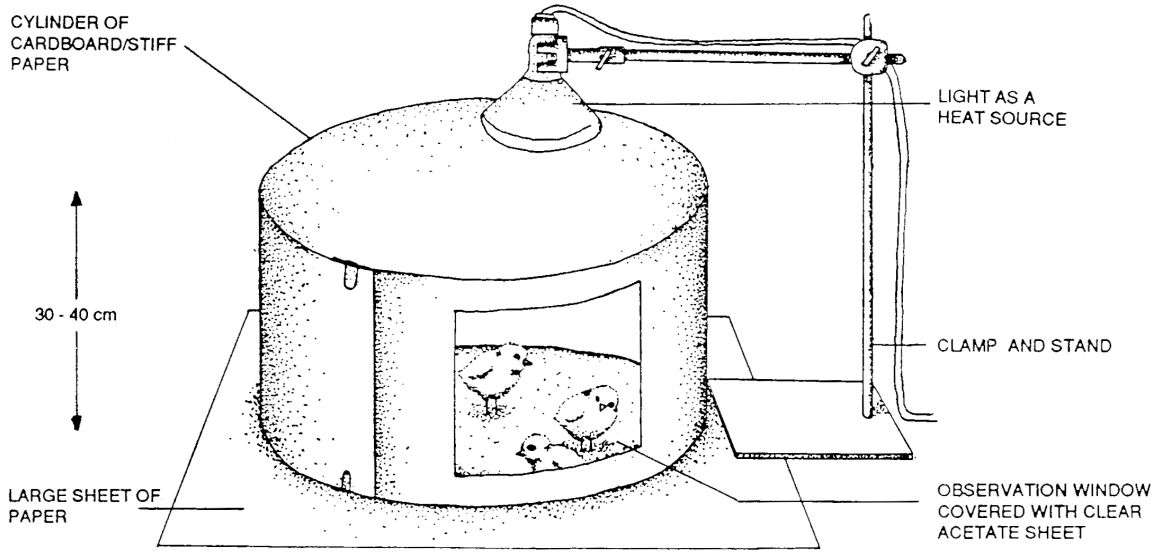
For those using the *Octagon 20* incubator, Brinsea Products sells a rearing module (A030 £82.70 inc VAT) (also sold by other suppliers) which consists of a plastic enclosure, on top of which is placed the *Octagon 20* heating unit.

Figure 5 The Brinsea Products *Cosy lamp* brooder

A HOME-MADE BROODER

It is, however, unnecessary to incur the expense of purchasing a ready-made brooder, though some outlay on a heat source will probably be required. An effective design for a brooder, shown in Figure 6, is a circle made out of a long length of cardboard or stiff paper about 30 - 40 cm in height; this is clipped together so that the diameter of the brooder can be increased as the chicks grow in size. Initially the diameter should be between 50 cm and 1 m for around one dozen chicks; alternatively, work on providing an area of 18 cm^2 per chick. Each week, the area enclosed by the cardboard is enlarged. If the brooder is on a table, to allow small children to observe the chicks, it is a good idea to cut a large hole in the cardboard and cover this window with a sheet of transparent acetate of the type used with overhead projectors.

Figure 6 A d-i-y brooder



For newly-hatched chicks, the size of the brooder should be such that they cannot stray far from the heat source. As they grow older they should be able to move away from the heat if they need to. Cardboard boxes of increasing size as the chicks develop might also be used.

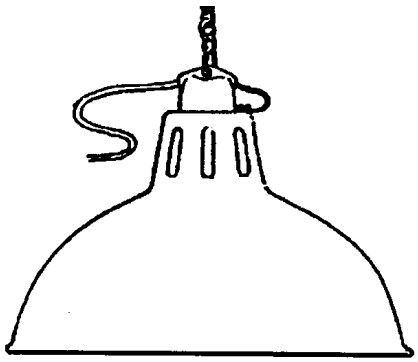
A SOURCE OF HEAT: AN INFRA-RED LAMP

A suitable heat source for the brooder is required and this is, ideally, an infra-red lamp which is suspended over the enclosure. If you have borrowed an incubator, from the same source you may also be able to borrow a complete brooder or just a heat lamp. It may be possible to borrow a lamp and holder from a local secondary school science department, so a few 'phone calls may be very cost effective!

LAMPS FROM VARIOUS SUPPLIERS

If it is impossible to obtain something suitable on loan, a number of suppliers sell infra-red lamps and holders. For example, Griffin Education supplies an infra-red heater consisting of a lamp, protective shield and built-in reflector (HCT-601-020B £53.85; spare lamp HCT-605-010D £10.50, both excluding VAT). Brinsea Products (and other suppliers) sell an infra-red brooding lamp (150 W or 250 W) for £49.95 inc VAT.

Figure 7 Infra-red heat lamp



SUSPENDING THE HEAT SOURCE OVER THE BROODER

Some means will be needed to suspend the lamp over the brooder. It has been suggested that a stand used to measure a child's height might be employed for this purpose. Alternatively, a retort stand (with a ***heavy*** base) and clamp can be used. These may already be available or might be borrowed from a local secondary school science department. If they need to be bought, they are sold by school science equipment suppliers. If using the heater above, the reflector should be suspended using the chain provided and not dangled by the flex.

AN 'ANGLEPOISE' LAMP AS A HEAT SOURCE

An alternative, possibly cheaper, though less satisfactory source of heat is to use an 'anglepoise' lamp. This is not designed to be used with higher wattage bulbs, so it is necessary to remove the lampshade or cover and insert at least a 100 W bulb. Check that this produces a sufficiently high temperature in the brooder, and if necessary use more than one lamp.

BROODER TEMPERATURE: INITIALLY 35°C

A thermometer to check the temperature in the brooder will be required; a simple room thermometer can be used for this. In the early days after hatching the chicks must be kept very warm at about 35 °C (95 °F). As they increase in size, the temperature can be reduced by about 3 °C (5 °F) each week. Chicks will need to be given some warmth in a brooder for about 6 weeks until they have acquired their adult plumage.

ADJUST LAMP HEIGHT TO VARY THE BROODER TEMPERATURE

Experiment with the height of the lamp above the brooder to obtain the correct temperature ***before*** adding the chicks. The lamp should not normally be lowered so that it is ***within*** the walls of the brooder as overheating may occur. When the chicks are installed, watch their behaviour and adjust the height of the lamp if necessary. It is normal for the chicks to avoid the central spot immediately below the lamp but, if they move to the periphery of the enclosure and possibly also show some distress with open beaks and panting, it is evidently too hot. Huddling together tightly is a sign that chicks are too cold.

6.3 Feeding and watering the chicks

FOOD FOR THE YOUNG CHICKS

Chicks that have *just* emerged from the shell do not require food for the first 24 hours; what is left of the egg yolk will provide nutrients during this period. Once the birds are ready to be moved to the brooder, an initial feed of finely-chopped, hard-boiled eggs is ideal. After the first day in the brooder, the chicks should be given high-protein chick starter crumbs. This diet could be maintained for the next 6 - 8 weeks but many introduce some chick corn into the diet after a couple of weeks. Some authorities suggest that for the first week, chick crumbs should be moistened with water or milk.

PURCHASING FOOD FOR CHICKS

A local pet shop may be able to supply such foods but not necessarily very economically. However, supplies are available from John E Haith, in 6 kg, 15 kg and 25 kg packs. Order 'High protein crumbs' and 'Poultry corn'; 'phone for a current price list. Special diets are available for other birds, if the eggs of ducks, quail etc have been hatched. (Note: cash with order is required with a delivery charge of £3.60 for orders less than £15, £1.99 for orders over £15 and delivered free for orders over £16.)

EXPECT A LOT OF FOOD TO BE WASTED

The chicks are very messy animals and will scatter much of their food about the brooder where it will become contaminated with their droppings. This wastage is inevitable, so more starter crumbs or poultry corn will be required than might be imagined. Because of the wastage, it is difficult to be precise about the exact amounts of food to be ordered.

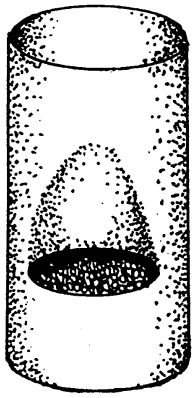
DO ***NOT*** USE OPEN DISHES

Food can be provided in shallow dishes but these can be overturned or fouled by the chicks and are not recommended. It is better that food is provided in one or more 'hoppers'. A local pet shop may have what you need but suppliers sell cheap plastic, 1 kg capacity feeders (eg, Hatch-it Incubators has a 10 inch feed trough for £4.25.

CONSTRUCTING A D-I-Y FOOD HOPPER

You can, however, manufacture food hoppers for yourself from washed-out tin cans. The top is cleanly removed so that there are no sharp edges. A cut is then made in the side of the can with a hacksaw about one third up from the base. Using tin snips or strong scissors make small vertical cuts at each end of the cut and with forceps or pliers fold the sharp, cut edges inside the can. Then press the can inwards above the cut to produce the feeding hole in the hopper. See Figure 8. Keep the hoppers regularly filled with crumbs or corn.

Figure 8 A home-made food hopper



ADDITIONAL 'GREEN' FOOD

A little green plant material such as chopped greens, lettuce, cabbage, water-cress or chickweed can be provided after the first week.

PROVIDING SUPPLIES OF DRINKING WATER

Water must be constantly available as the chicks drink regularly. Initially, they may need to be encouraged to drink by attracting their attention to the water source. This can best be achieved by placing the water container on top of a piece of aluminium foil. If this fails, dip the chicks' beaks in the water! Open dishes of water should be avoided because of the problems of fouling and some form of drinking 'fountain' is preferable. Provide *two* drinking fountains in the brooder to ensure a constant supply of water in case of mishaps.

USING PET SHOP WATER FOUNTAINS

Drinking fountains can be purchased from pet shops or specialist suppliers such as Hatch-it Incubators which sells a 1 litre plastic drinker for £3.00. By using water containers designed for bird cages, as shown in Figure 9 overleaf, the problems of fouling by the chicks can be reduced.

An easily-constructed design of water fountain is shown in Figure 10 overleaf. If you do not have a suitable shallow container, again ask a local secondary school science department if it can spare a glass or plastic Petri dish or two! Even this design of drinking fountain is still likely to become contaminated by the chicks and will require regular cleaning.

Figure 9 Using bird cage water containers

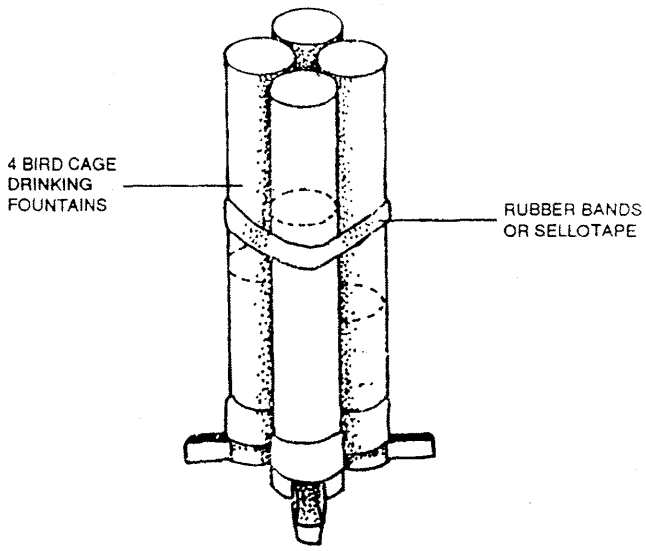
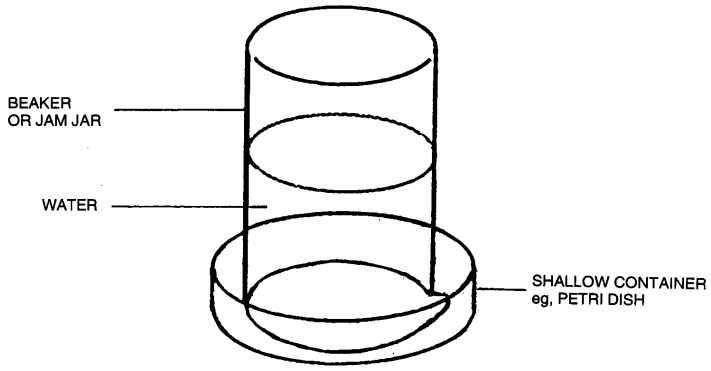


Figure 10 A home-made water fountain



CHICKS' MESSY HABITS

Because the chicks are so messy they will need to be cleaned out at least daily, with a fresh sheet of paper (and wood shavings, if used) to line the floor of the brooder. Food and water containers will need to be similarly cleaned out and replenished. Teachers should consider the best way of involving pupils in this important activity.

LOOKING AFTER CHICKS AT WEEKENDS

There are particular problems at weekends as the chicks must ***not*** be left unattended for such a long period. Arrangements must therefore be made for the chicks to be inspected and their food and water supply topped up.

It is sensible to increase the number of food and water containers in the brooder over the weekend but this should not be a substitute for personal attention. When food and water have become contaminated, the chicks are less inclined to use the fouled containers.

After about four weeks the chicks will begin to develop their adult plumage. They will continue to need some additional warmth until their adult feathers are fully developed when it will be possible to keep them outside if desired.

6.4 Keeping adult chickens

YOUNG BIRDS MAY NEED TO BE KEPT FOR AROUND 6 - 8 WEEKS

Although many schools will not intend rearing adult chickens, it must be appreciated that whoever has agreed to receive the animals may not have facilities for keeping *young* chicks. In these circumstances, it will be necessary for schools to keep the birds until they are sufficiently mature to be handed on.

A decision to keep adult chickens after their time in the brooder must not be made without considerable thought; rearing the adults is a major undertaking. It will be essential to ascertain whether there are any local authority bylaws or restrictions on keeping livestock on the school premises. Neighbours may not

appreciate being woken by cockerels crowing early in the morning, so obtaining their consent may be prudent! The full and whole-hearted approval and co-operation of the school premises manager is also quite essential! It is not within the scope of this guide to give full details of rearing adults and there are several publications which can provide extensive discussion; see section 11. Nevertheless, a brief outline of what is involved is given below.

OUTDOOR ACCOMMODATION INCLUDING A COVERED RUN WILL BE REQUIRED

The adults will need housing that provides a secure, dry shelter in which they can roost and escape inclement weather. Consideration should be given to the probability that mice and rats will be attracted unless precautions are taken; a shelter raised off the ground will make it more difficult for vermin to become established. The shelter should have at least one raised perch and, to facilitate cleaning out waste, it is customary to fit a board below the perch onto which the birds' droppings will fall. The floor of the housing should be covered with wood shavings, peat moss substitute and / or straw. Feeders, drinkers and nest boxes will also be required. If one of the aims of keeping adult chickens is to collect the eggs that are laid throughout the year, it will be necessary to provide artificial lighting in the shelter to extend the natural day length during the short days of the winter months. Note too, that only the female birds that hatch will be required; other arrangements will need to be made for the males in the brood; **see section 8**.

In addition, some form of outside, covered run will be needed. 50 mm mesh wire netting fixed to a framework will contain the birds and keep out larger animals, such as dogs and foxes. Chickens are extremely messy animals and so the area in which they will be kept will require very frequent cleaning.

FEEDING THE ADULTS: LIMITED KITCHEN SCRAPS + A SOURCE OF GRIT, CALCIUM and VIT. D

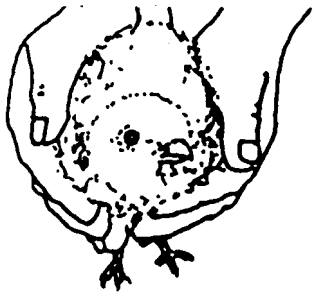
Chickens have a fairly omnivorous diet. Their normal food will be poultry mash, supplemented with corn [eg, from local corn merchants (see *Yellow Pages*) or John E Haith]. Although, traditionally, chickens have been fed on all sorts of household vegetable scraps, these should *not* form the major part of their diet. Over-feeding with scraps prevents the birds eating the poultry mash which contains the proteins, vitamins and minerals they require for egg production. They will, in addition, require a source of grit for grinding the food in their gizzards, eg, limestone grit and crushed oyster shell grit (available from John E Haith). The oyster shell grit is a convenient source of calcium in the diet as some of this is soluble. An additional source of vitamin D is recommended. This can best be provided by mixing the poultry corn in a little cod-liver oil before feeding the animals.

6.5 Rearing birds other than chickens

CHOOSE DUCKS OR OTHER SPECIES ONLY AFTER GAINING EXPERIENCE WITH REARING CHICKENS

Again, it is outside the scope of this guide to give much advice here. There have been many publications produced over the years describing what is involved in rearing species such as ducks, geese, turkeys, quail, pheasants etc. Suitable references may be obtained from local libraries; **see also section 11**. Of the alternatives to chickens, the duck is perhaps the most likely bird to be chosen for studies in schools. Ducks are certainly delightful animals and their slow hatching is a definite bonus. However, we would not recommend that teachers attempt to rear ducklings until they have been successful with chickens. Ducks are ***extremely*** messy animals; they splash water everywhere and leave very liquid droppings! The litter on the floor of the brooder soon becomes very wet unless complicated arrangements are established with a raised pond and ramp. Providing food is more of a problem in that supplies have to be wet and feeding is a messy business; the animals need to be able to clean their beaks which quickly become coated with food. Water is consumed very rapidly and so water fountains need to be checked and topped up very often. Weekends are a particular problem in ensuring continual supplies of food and water.

7. HANDLING and SEXING



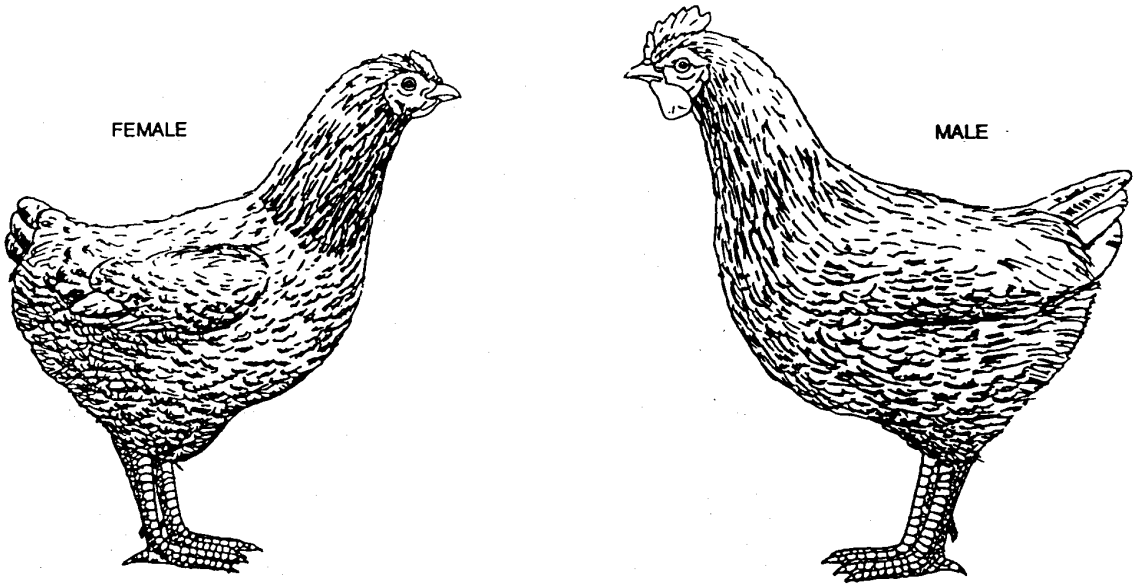
HANDLE CHICKS BY CUPPING IN THE HANDS

The chicks when first hatched are extremely weak and delicate and, unless in obvious distress, should not be handled for the first few hours, until their plumage has dried and they are able to stand. They are then best picked up by cupping gently in both hands. The legs should project through the fingers or the bottom of the cupped hands. The aim is to restrain the animal and not squeeze it tightly. The neck is particularly fragile, so care should be taken when handling. As the birds grow older, essentially the same technique is used, approaching the animal from behind and holding the wings down against the sides of the body while lifting with both hands.

To avoid undue stress to the chicks, handling by children must be carefully supervised and *kept to a minimum*. See also comments on hygiene **in section 9**.

SEXING MOST CHICKS IS EXTREMELY DIFFICULT

While the chickens are immature, sexing is definitely a job for the expert unless eggs are hatched of a particular variety which has slightly different markings on the plumage in males and females (eg, Warren variety). For most people, sexing at this stage is not really feasible. As the birds mature, however, and begin to develop their adult features, sexing becomes somewhat easier, for example, when the birds are 8 - 10 weeks old. The males are generally larger animals with bigger and brighter combs on top of the head and larger folds of fleshy skin below the beak. Both hens and cocks have a spur on the back of each leg but this tends to be larger in males.



8. DEALING WITH UNWANTED, DISEASED or INJURED ADULTS

MAKING PLANS IN ADVANCE

As discussed in sections 1 and 2, unless a decision has been taken to keep the hatched chickens, it is ***essential*** that plans are made in advance to find a suitable home for them. To avoid doing this is irresponsible and humane destruction should ***not*** be used as a convenience. It is also unacceptable to assume that local contacts will automatically be willing to take your animals and so present them with a 'fait accompli' once the birds have hatched. Firm arrangements ***must*** be made before incubation work commences.

CONTACT RURAL & CITY FARMS

There are often a number of people willing to accept small numbers of chickens and local farms are obvious potential homes. See *Yellow Pages* under 'Farmers' for possible contacts in rural areas. In urban areas there are a number of City Farms. The National Federation of City Farms and Community Gardens produces a listing of establishments; refer to the NFCFCG web site if you would like to find out if there is a city farm near you. If you have borrowed equipment for the project from a local source, it is possible that you will be able to include the chickens when you return the incubator. Contacts in local teachers' centres and agricultural colleges may also be fruitful.

ONLY HENS OR ADULTS MAY BE ACCEPTED

It should be noted that some of the farms may only be able to take birds when fully mature and that others will only take ***hens***. Some will accept both males and females but it must be realised that only the females which lay eggs are usually of interest and the males may be killed for food. In all cases, contacts must be made well in advance to determine whether there is space available for your chickens or whether certain conditions will be imposed.

HUMANE KILLING

As a result of chicks hatching with some deformity (such as an external yolk sac which has not been reabsorbed), developing an illness or being injured in an accident, humane destruction may be required. In schools, the only acceptable method is to induce unconsciousness with carbon dioxide gas and then use an overdose to kill the animal. This obviously poses severe problems for most establishments! (Details of what is involved are included in our guide L52, *Small Mammals.*) Traditional mechanical methods of killing chickens involving wringing their necks, although quite humane when practised by an expert, are clearly inappropriate for use in schools.

PREPARING PUPILS TO COPE IF CHICKS HAVE TO BE DESTROYED

Pupils may be very distressed when deformed chicks are hatched and have to be humanely destroyed. Teachers should prepare pupils, in advance, for the possibility that something might go wrong.

USE OF A LOCAL VET OR THE PDSA

Where facilities are not available for humane killing, the animal should be taken to a local vet but this will usually incur a fee. The location and business hours of a suitable vet should be identified in advance. If there is a local PDSA treatment centre near your school, animals will be humanely destroyed at no charge (though the PDSA normally only offers its services to people with limited finances so, arguably, a school should not use the PDSA).

9. HEALTH and SAFETY

DISINFECTING THE INCUBATOR

Disease is unlikely to be a problem if suitable precautions and procedures are adopted. It is important to disinfect the incubator before and after the incubation period. For details of suitable disinfectants, see the information in the footnote on page 22.

All other items which come into contact with the animals after they hatch should be disinfected and cleaned before and after use. As the chicks and adults are particularly messy birds, it is important to clean up after them *very* regularly, again disinfecting the area adequately, as necessary.

DISPOSAL OF REMAINS

All the remains of the eggshells after hatching, any unhatched eggs and soiled paper and litter from the brooder should be disposed of hygienically by wrapping in newspaper and placing this inside a plastic sack before disposal in the normal refuse.

THE IMPORTANCE OF GOOD HYGIENE

It is ***essential*** that whoever is involved in looking after the incubator and brooder or handling the eggs and, later, the chicks, is aware of the need for good hygiene ***and*** is able to wash hands thoroughly and dry them hygienically with paper towels or their equivalent, both before and after coming into contact with the animals and equipment.

SALMONELLA

Such precautions are standard practice when working with ***any*** animal or plant material but are particularly important in work with chicks because of the possibility that the eggs and the hatched birds might be carrying *Salmonella* bacteria which can cause food poisoning. The risk of infection can, however, easily be reduced to insignificance if simple hygiene is practised.

It may be wise to discourage the handling of chicks by any child who is known to be allergic to animals. Similarly, any cuts in the skin on the hands should be suitably protected before chicks are handled.

DANGER OF BIRDS DEVELOPING RICKETS

Young and adult chickens can easily develop rickets if an adequate supply of vitamin D and calcium is not included in their diet. This should not be a problem if good-quality feed plus grit (such as crushed oyster shells) are used.

SUSPECTED ILLNESS **MUST** BE NOTIFIED

It is most unlikely that the hatched chickens will show any signs of infectious disease but if some ailment is suspected, it is *essential* that the animal is taken to a vet. This is because certain conditions, such as Newcastle's disease, must by law be notified to the authorities. In these circumstances, it is not sufficient just to destroy the animals humanely.

10. STUDYING EGGS and CHICKS

There can be few more exciting activities in schools than incubating eggs and then watching the hatching process and early development of the birds. Obviously, such activities will support aspects of work in the Programmes of Study at Key Stages 1, 2 and 3 of the Science National Curriculum. Several aspects of the work will provide a stimulus for further studies in maths, English, PSE, etc.

Some suggestions are given below to provide ideas of the possibilities. See also section 11.8.

10.1 A study of reproduction and development

COMPARING CHICK DEVELOPMENT WITH THAT OF OTHER ANIMALS

Work on the incubation and hatching of chicken or duck eggs can be a part of a wider study on this topic in several animals, including small mammals. This broader approach is useful because it will allow the various important points of similarity and difference in the reproductive processes of different animals to be emphasised. Thus, in most fish and amphibia, there is external fertilisation and development outside the body in the water; in most mammals all stages of reproduction are completely internal. The reproduction of the chick falls midway between these two extremes, with fertilisation and initial development which are internal, followed by an extended period of external development which places few demands on the mother, other than her contribution as a heat source.

THE ADVANTAGES & DISADVANTAGES OF DEVELOPING INSIDE AN EGG

There is clearly more protection inside the egg for a developing chick embryo than for young fish or amphibia but much less than is enjoyed by a mammalian embryo. Being enclosed in a protective eggshell creates problems for the chick as well as solving some for the mother. The embryo needs an adequate source of food to complete its growth up to hatching time; it must be able to receive adequate oxygen for respiration and to remove wastes such as carbon dioxide and nitrogen-containing substances. The 'design' of the egg and the way the embryo develops are both related to a solution of these problems and, when studying the incubation of the eggs, it is valuable to highlight the reasons for the precise regulation of several environmental conditions. (See section 10.2.)

CHECKING THE INCUBATED EGG FOR SIGNS OF LIFE

While eggs are being incubated there is clearly only a limited amount of observational work that can be undertaken. One fascinating activity is to float an incubating egg in warm water at 40 °C for a short time and to look for signs of movement of the developing chick (or duck etc) inside the egg, revealed by a slight kick of the floating egg. There is little point in trying this early on in the incubation period but towards the end of development you can find out when the embryo starts to become active. (It is obviously important not to allow an egg to cool down significantly as a result of these observations and the egg should be dried carefully before returning it to the incubator.)

MONITORING DEVELOPMENT BY MEASURING WATER LOSS

As discussed in section 5.2, page 25, the natural loss of moisture from the developing eggs can be studied and allow pupils to make measurements and plot graphs. As moisture is lost, the mass of the eggs will fall. The loss of moisture is an essential feature of development and a fall of between 12 – 15% of the initial mass during the entire incubation period will normally be seen if the correct humidity in the incubator is maintained. Such measurements at regular intervals can help to check that an appropriate humidity is being provided in the incubator.

Batches of, rather than single, eggs can be weighed at say 0, 7 and 14 days; this will increase the mass to be measured and help to increase reliability if your balance is not very accurate. The ideal loss of mass (say 12%) can be calculated from the initial readings and used to plot a graph of expected mass at various times during incubation; see Figure 3, page 26. The actual mass of the eggs can then be plotted alongside to check progress. Figures of about 1 - 2% either side of the ideal readings are acceptable without the need to adjust the humidity of the incubator. Again, ensure that eggs are not removed from the incubator for too long when they are weighed.

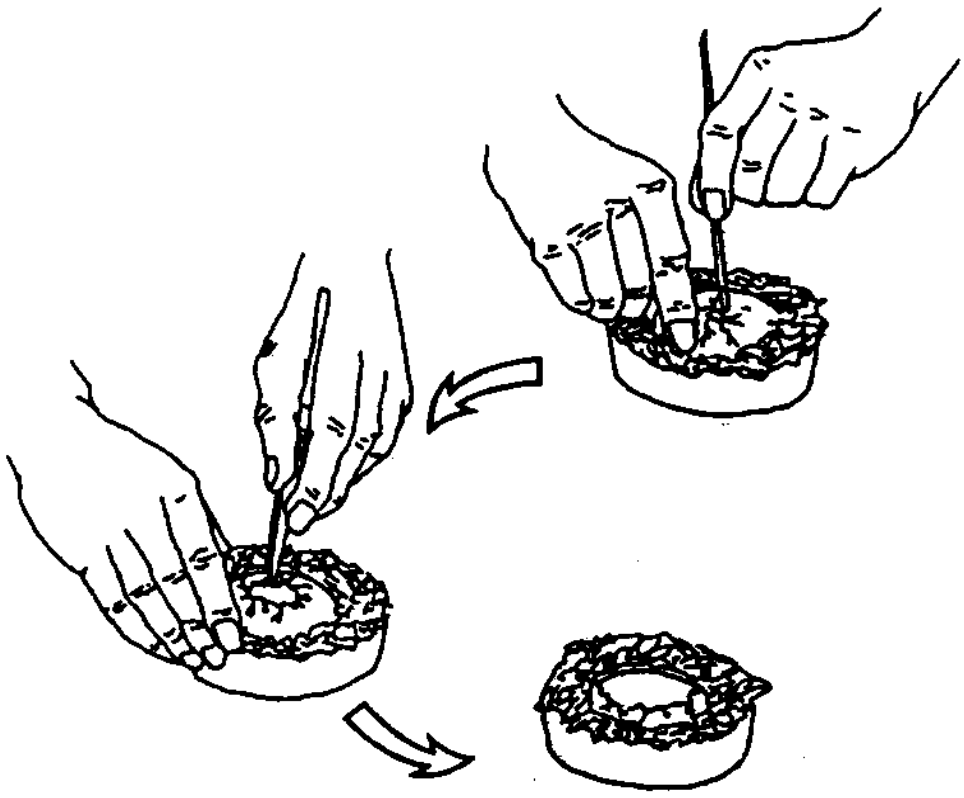
10.2 The structure of an egg

Eggs are familiar to most people but it would be unwise to assume that because of this, children will have appreciated the detailed structure of the egg or related this to the needs of the embryo.

INVESTIGATING WHAT'S INSIDE AN EGG

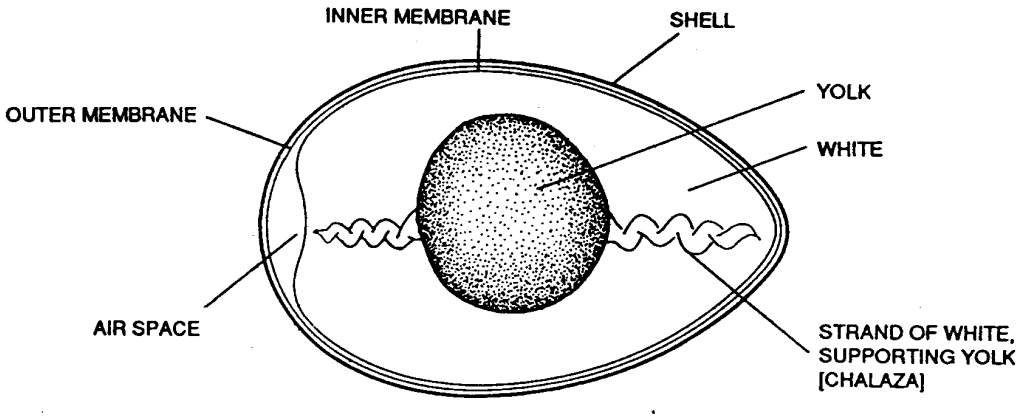
During the work on egg incubation, while waiting for the chicks to hatch, studying the structure of an egg can be a valuable activity. This can best be done by hard boiling eggs and then chopping them in half along their long axis (still inside the shell if possible). Comparisons can then be made with a raw egg. This is best studied by placing the egg in a dish lined with tissues and making a window in one side by carefully chipping away the shell and membranes with forceps or tweezers.

Figure 11 Opening up a raw egg



Important features of the 'design' of an egg are shown in Figure 12 and discussed overleaf.

Figure 12 The contents of an egg



THE PARTS OF AN EGG AND THEIR FUNCTIONS

(i) The ***shell*** - which is porous (it must be to allow oxygen in and carbon dioxide out). If possible, look at a piece of shell under a microscope to see the holes.

(ii) The ***membranes*** - which help to prevent too much water being lost through the pores in the shell (a necessary evil to allow gas exchange). Blood vessels from the developing embryo later form a network beneath the membranes which then act as a surface to help exchange of gases in and out. Turning the egg during incubation helps to prevent the embryo, in its early development, from sticking to the membranes.

(iii) The ***egg white*** or ***albumen*** - which has a cushioning effect, protecting the embryo against mechanical shocks when the egg is moved. In addition, it is a source of water which can stop the chick embryo dehydrating and acts to conserve heat so that the embryo is protected from the cold for the short period when the mother moves off the eggs.

(iv) The ***yolk*** - the food supply for the embryo, which begins as a small disc on the top of the yolk. As the embryo develops, blood vessels grow out from the chick over the surface of the yolk to absorb the nutrients more efficiently. These vessels can sometimes be seen when candling the developing egg during the first week of incubation.

(v) The ***chalaza*** (plural ***chalazae***) - two strands of egg white which support the yolk in the middle of the egg. The weight of the egg yolk will keep the embryo at the top of the egg (and so nearest to the warmth of the mother bird's body) even when it is turned. The chalazae serve a vital role in suspending the yolk but allowing it to turn.

(vi) The ***air space*** - which is always at the broad end of the egg. This acts as a supply of air which the chick breaks into when about to hatch and begins to breathe using its lungs. The oxygen supply in the air space helps in the strenuous efforts of the chick to chip its first hole through the shell.

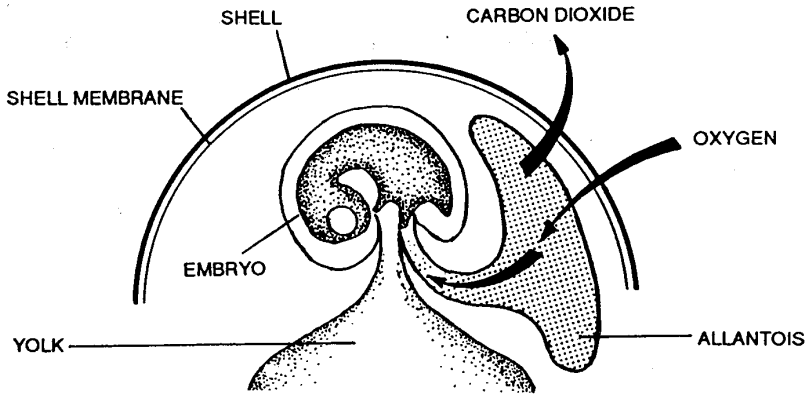
OPENING UP FERTILE EGGS: BEWARE OF PUPILS' REACTIONS

If it is thought appropriate, a fertile egg can be examined in the same way and the disc of the developing embryo seen on the top of the yolk. This will, however, possibly cause some distress to pupils as the embryo (although at this stage not recognisable as a young bird) will inevitably die once the egg is opened. Teachers must be very sensitive to the emotions of their pupils and consider whether this procedure is advisable, or necessary, because other materials are available to show the embryo within the egg. (In any discussions on this, it might be helpful to point out that people who prefer free-range eggs may at some time have eaten some which were fertile!) Once the eggs are incubated and the embryos become more recognisable as birds, opening the eggs to examine them will certainly distress many pupils. In these circumstances, it would be most unwise for teachers to consider proceeding with such investigations and they must discuss the issue with their pupils before starting. In any event, teachers must ***not*** open eggs containing live embryos which have been incubated for more than **ten** days; (this is a **legal** requirement).

FUNCTIONS OF THE ALLANTOIS

One aspect of the development of the chick within the egg which is not easy to investigate is nevertheless quite vital for its survival. This is the formation of an outgrowth from the embryo called the ***allantois***; see Figure 13. This enlarges quickly; it grows over the embryo and lines much of the inner surface of the egg. It functions as a gas-exchange surface.

Figure 13 Developing membranes in the egg



The allantois also serves as a storage area for nitrogen-containing wastes, particularly a substance called uric acid. This is quite poisonous and needs to be removed from the body but it can be excreted as a *solid*. Complete elimination of the uric acid is obviously difficult for the chick, enclosed in its shell, but the problem is solved by the allantois; the solid uric acid stored there is isolated from the embryo where it can do little harm. When the chick hatches, a pellet of solid material can often be seen inside the shell which is the uric acid deposited within the remains of the allantois. As mentioned earlier in section 6.1, the remains of the allantois can sometimes be seen still attached to the newly-hatched chick.

RELATING EGG STRUCTURE TO THE CONDITIONS OF INCUBATION

In studying the structure of the egg, and considering the function of its various parts, the reasons for the precise control of conditions in the incubator should become obvious. As the chick embryo is so small, it is in danger of losing heat quickly and so retarding or stopping its growth. It naturally needs to be kept at the normal body temperature of a hen to ensure that the various body functions can be carried out normally. The raised humidity is essential to prevent too much moisture being lost through the porous egg shell. Adequate ventilation is vital to provide oxygen and also to remove carbon dioxide which will kill the embryo if it accumulates.

USE OF LEARNING MATERIALS AND VISITS TO EXTEND OBSERVATIONAL STUDIES

What is often missing in any study of reproduction in the chicken or duck is an appreciation of the events leading up to the egg being laid, as well as changes occurring within the egg. By the appropriate use of books and audio-visual materials, however, aspects of reproduction involving courtship, copulation, fertilisation and development within the egg can readily be illustrated and discussed. A visit to a local rural or city farm that keeps chickens can also be valuable. Details of some learning materials are given in section 11.

10.3 Science from eggs

INVESTIGATING THE STRENGTH OF AN EGG

Some interesting ‘side-line’ activities might arise from the study of eggs to discover their structure. Children often consider eggs to be rather fragile objects; they are, after all, easily broken. Pupils are therefore very surprised to discover that eggs can withstand considerable pressures before breaking, especially if the force is exerted with an egg standing on one end (using a small cup cut from an egg box to support it). There is much scope here for experimenting, measuring and recording. What influences the strength of an egg? - its size? - its colour? - its freshness? Does it matter how a force is applied to the egg, for example, either gradually loading it with weights on top of a board resting on the egg, or adding them quickly with a sudden jolt? How should the tests be performed so that they are *fair*? How might the way an egg is laid by the hen relate to its strength when ‘squeezed’ in different ways?

WHAT MAKES EGGS CRACK WHEN THEY ARE BOILED?

Another familiar observation worthy of investigation is the infuriating habit of eggs breaking when being boiled. Various 'cures' are often recommended: adding salt or vinegar to the water, or adding the eggs to cold water and then boiling them. Do they work? If so, why and why do the eggs break anyway? The clue to understanding what is happening involves the porous nature of the egg shell and the air space. It is thought that on rapid heating the volume of the air inside the space expands quickly so cracking the shell and allowing the contents to escape. If water is gradually warmed from cold, the slowly expanding air has time to escape through the pores of the shell. Puncturing the broad end of an egg with a pin will provide a vent for the expanding gases and should also solve the problem! Adding salt and vinegar (increasing the acidity) affects the nature of the proteins in albumen, causing them to denature and coagulate. These cures might therefore work by sealing any cracks that develop, preventing further leakage. Again there is much scope for observation and investigation!

10.4 The chicks hatch

INVESTIGATING HATCHING

Once the embryo has completed its development, there is obvious excitement among the pupils and plenty of opportunity to encourage close and careful observation, accurate measurements of various factors plus suitable methods of recording and display; all essential components of science activity.

Do all chicks begin to hatch at the same time? (Interestingly, chicks placed in the incubator at different times can all hatch together under certain circumstances.) Once the first hole appears in the egg, how long does it take for the chick to emerge fully from the shell? Is this time the same for all the chicks? Is there any relationship between the mass of the egg and the mass of the bird once its feathers have dried? Is this perhaps linked to its strength in escaping from the egg? (A chick can easily be weighed in a container on top of a set of sensitive scales or perhaps placed inside a plastic bag and suspended from a spring balance.)

10.5 Observing chicks

INVESTIGATING THE CHICKS' EYESIGHT

When the chicks have dried and recovered from their hatching ordeal, they can be handled and moved to the brooder. Now pupils can observe them closely, noting their important features and behaviour. Of particular interest at this time is the egg tooth on the beak which was used to help the chick break out of the egg. This soon disappears now that its task is over. Do the chicks have ears? Where are they and how are they different from those in other animals? Look at the eyes. Where are they placed on the head and how does this compare with other birds, particularly predators such as owls? How is this, and the field of vision the eyes provide, related to the behaviour and lifestyle of birds? (Chicks often will peck only at bright objects and ignore food scattered on the floor of the brooder. There is lots of scope here to investigate what the chicks can see, with various objects of different sizes and colours presented to them on different coloured surfaces, and their pecking at these objects recorded.)

10.6 Recording growth & development

CHARTING GROWTH AGAINST FOOD AND WATER CONSUMPTION

Pupils will enjoy keeping a daily diary of the chicks' development. Information can be recorded here of the day-to-day changes that occur in behaviour and appearance of the chicks. Quantitative studies of growth can easily be undertaken by weighing daily the food that is given and comparing this with the mass of the birds when they are weighed; (food conversion efficiency is rarely greater than about 10%). Tables and graphs of data can be compiled showing rates of development. The need for taking average readings from all the birds will become evident because of individual variation, particularly if gain in mass is related to food given. Pupils might wish to consider the discrepancies between mass of food presented and the readings obtained when the chick is weighed. Wastage of food in the brooder will be a factor but water consumed will not be unimportant either.

Pupils should be encouraged to think how water consumption could be measured accurately. Calibrating the water level in the drinking fountain can be attempted but a lot of water will simply evaporate from the dish. The need for recording water loss from an identical control fountain kept at the same temperature as that in the brooder may be suggested.

An additional factor will be the amount of droppings produced. This could be measured by weighing fresh sheets of paper lining the floor of the brooder at the beginning and end of each day.

10.7 Investigating feeding

WHAT FOODS ARE PREFERRED?

Work on pecking at objects will readily extend into a study of feeding. It is unwise to allow children to experiment too extensively on the foods that the chicks will eat, as in this way the birds can easily be given a quite unsuitable diet. As the birds mature and can take larger pieces of food, it is interesting to investigate which foods are preferred and whether this is related to the size, colour etc of individual items such as corn and grain. Findings here can then be extended to include studies of wild bird populations, particularly pigeons, outside the school.

10.8 Investigating heat loss

Even if all the aspects affecting gain in mass have been considered and measured, the mass of the chicks will not match their food and water intake. For older pupils, this observation could lead on to a study of the use of food in keeping the animals warm by generating heat. One reason why commercial hatcheries brood their chicks at high temperatures is to reduce feed costs as less food is then used up in maintaining body temperature. Another reason why the chicks in school need to be kept warm is the ease with which heat is lost to the surroundings. This is particularly a problem for the small chicks which have a large surface area relative to their size. (As they grow, the surface area to volume ratio drops and so there is less heat loss. This is one reason why the temperature in the brooder can be reduced each week.)

USING TIN-CAN 'MODELS' OF CHICKS TO STUDY HEAT LOSS

It will not be possible (or humane) to investigate heat loss directly with the chicks. 'Models' of chicks using bottles, flasks or tin cans of different sizes can, however, be used. These can be filled with hot water from a kettle and the speed with which their temperatures drop, as measured by a thermometer, are recorded and related to the size of the container. Depending on the age and interests of the pupils, this work can be developed into an extensive scientific activity.

10.9 Working with feathers

FEATHERS: FOR INSULATION, FLIGHT AND DISPLAY

Children will be quick to point out that the cans or bottles used to make models are not very representative of the actual chicks which are covered with insulating feathers. The containers can then be coated with feathers (a feather duster or pillow can be sacrificed in the name of science!) or alternative insulators used to determine the effects on heat loss.

It will be important to examine the structure of feathers in this work to see how they perform their insulating task so well. As the chicks develop their adult plumage, the differences between the initial down feathers and their larger replacements can be studied and related to their different functions. If appropriate, this work can be developed into investigations on flight or the use of feathers for display and courtship in a variety of birds.

10.10 Studies of chick behaviour

INSTINCTIVE AND LEARNED BEHAVIOUR

Because incubator-reared chicks never see their parents, their behaviour patterns, at least initially, must be instinctive, though later there is the opportunity of learning from other birds. Chicks must obviously be capable of fending for themselves immediately after hatching, unlike other newly-emerged birds which are quite dependent on their parents for food for some time.

A comparative study of the behaviour of chicks with those of other species will reveal many differences.

ENCOURAGING CAREFUL OBSERVATIONS

In any behavioural study, the important factor is careful observation and recording. Chicks provide excellent material for encouraging such basic scientific skills. If eggs have been incubated at different times, or full daily diaries compiled, the changes in behaviour that occur with age can be highlighted. Comparisons are best made between one- and nine-day old chicks; Table 4 shows some of the easily recognised behaviour patterns that are displayed and how they differ with age.

It is essential that any investigations of the chicks' behaviour do not cause harm or undue stress.

LISTENING TO THE SOUNDS THAT CHICKS PRODUCE

Pupils can be asked to view a group of chicks quietly for some time and make a list of the number of times each type of behaviour is seen. As suggested earlier, pecking and feeding behaviour are easily studied. Different types of sound made by the chicks should be distinguishable. If a new source of food is placed in the brooder, chicks will often produce pleasurable twittering noises as they feed and drink. Chicks will regularly make distress calls, particularly if they become a little cold or become separated from other animals. Distress calls are thought to be elicited in unfavourable circumstances to attract the attention of the mother hen. The presence of other chicks will affect the frequency of distress calls and this can easily be investigated. Alarm calls are often produced when a chick is pecked by another or when the chicks are disturbed by sudden movements.

Table 4 Behaviour patterns of chicks

	Age of chicks	
Behaviour pattern	**1 day**	**9 day**
Walking	✓	✓
Pecking at the ground	✓	✓
Drinking	✓	✓
Wiping the beak	✓	✓
Shaking the head	✓	✓
Preening the wings	Not a lot	✓
Raising both wings	×	✓
Extending leg and wing on one side	A little	✓
Scratching the ground	×	✓
Twittering pleasurably	✓	✓
Distress call	✓	✓
Alarm call	✓	✓
Resting standing up	✓	×
Resting sitting down	×	✓

The timing of many of the pieces of behaviour can also be studied. Do they occur randomly or is there any pattern? Are any related to feeding and drinking times, to disturbance or to sleeping and resting times?

INVESTIGATING THE CHICKS' BEHAVIOUR OF MOVING TOWARDS EACH OTHER

One aspect of chick behaviour in particular can be used for detailed studies: the approach of one chick to another. If two chicks are placed about 30 cm apart, after a short pause, one chick will approach the other.

i) Repeat this several times. Is it always the same chick that approaches the other? On repetition, does the time taken before one chick approaches the other decrease?

ii) If one chick is separated by between 40 - 50 cm from a pair of chicks, which animals move? (ie, which is the most attractive stimulus for moving?)

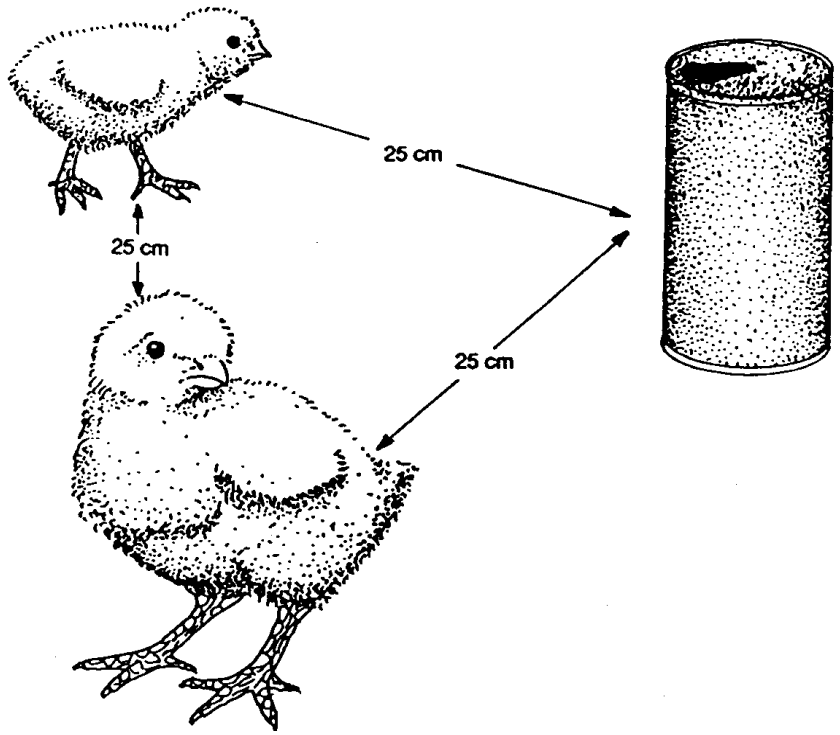
iii) Will a chick approach a reflection of itself in a mirror?

iv) Does a chick prefer to approach another chick rather than an inanimate object of the same size and colour? (The choice arrangement to be used is shown in Figure 14).

v) What feature(s) of a chick are important in initiating an approach movement? (Try making models of chicks in which one feature at a time is changed. For example, make models out of cotton wool dyed yellow or left white. Make models with and without feet, with and without heads, eyes, beaks etc. Does the size of the model affect how chicks approach it?).

vi) Is the approach response entirely visual? (Place two chicks about 50 cm apart with a larger sheet of card in between them so that they cannot see each other but can hear any calls made. How do they behave? Then move the card away and see what happens.)

Figure 14 Investigating chicks' preferences



These are just some examples of possible detailed observational studies. Inevitably, further ideas will be suggested by pupils as a result of watching the chicks in the brooder and these can be explored as appropriate.

11. SOURCES OF INFORMATION and LEARNING MATERIALS

For addresses of suppliers, refer to section 12. Items marked * are more useful for work with younger children.

1. BOOKS: in print

FROM A & C BLACK, (distributed by Macmillan)	Stopwatch series: **Chicken and Egg*	Hdbk Pbk	0713624256 071363619X	£4.95 £4.50
	A magnificent photographic guide to chick development.			
	Home Poultry Keeping G Eley		0713663197	£7. 99
	A useful reference for those wishing to keep the chickens after hatching and brooding.			
FROM BRINSEA PRODUCTS	As well as manufacturing incubators, Brinsea also supplies various books that will be of interest to schools intending to keep the adult chickens they have hatched or incubate the eggs of other species such as ducks, geese or quail. Contact Brinsea for a current list of titles.			
	Other suppliers also have books. Contact individual suppliers for their latest lists.			
FROM CHRYSALIS CHILDREN'S BOOKS	*Baby Animals* series: **Chick*		1844580873 (Hdbk)	£10.99
	For children 4 - 6 years; information book with big, bright photographs.			
	How Things Grow: **From Egg to Duck*		1841383716 (Hdbk) 1844582566 (Pbk)	£10.99 £5.99
	For children 4 - 7 years; photographs and clear, simple text.			
	Life Cycles series: **Ducks and Other Birds*		1841388645 (Pbk)	£5.99
	For children 7 - 10 years; an in-depth look at life cycles.			
FROM DOMESTIC FOWL TRUST	This maintains and supplies rare domestic breeds as well as fertile eggs. It produces a range of books in the *Golden Cockerel* series which ranges from guides for beginners to specialist books on rare breeds. Details are on the DFT web site.			
FROM DORLING KINDERSLEY	*Watch Me Grow* series: *Duckling*		1405301600	£4.99
	For children 4+ years: an animal's eye view on the growth of a chick.			
FROM TTS	From *Life Cycles Big Book* series, **Lifestyle of a Chicken Big Book* (no SBN, but code SBIGCHICK)			£18.50
	This has large photographs showing every stage of the life cycle.			
FROM FRANKLIN WATTS	*Life cycles* series: *From Egg to Chicken*		0749631449	£5.99
	For children aged 4 - 11 years, a simple introduction ti life processes.			
	Watch It Grow series, **Duck*		0749661194	£5.99
	For younger children, helps develop an understanding of the needs, reproduction and growth processes of ducks.			
FROM WHITTET BOOKS	*Ducks* D Tomlinson		187358024X	£7.99
	A chatty, readable book which provides interesting facts about all manner of ducks.			

2. BOOKS: out of print

Several useful titles are no longer available for purchase but may be easily accessible in libraries or even for sale on e-Bay or Amazon web sites.

A selection of the titles is given below.

FROM DORLING KINDERSLEY	*Egg*		0751351032
	Over 200 excellent photographs, with accompanying text, illustrating the hatching of animals from their eggs. It covers a wide variety of birds and also fish, amphibia, reptiles, molluscs and insects. Excellent material.		
	Shaped Board Books: **Chick*		1859481027
	A bright and colourful book in the shape of a chick, illustrating the animal with many full colour photographs.		
FROM DRAGON'S WORLD	*Nature's Treasures* series: *Ducks*		1850282897
	A well-illustrated, general information book on a variety of ducks.		
FROM LERNER PUBLICATIONS	*Natural Science* series:		
	Inside an Egg S A Johnson	Hdbk	0822514729
		Pbk	0822595222
	An excellent, well-illustrated guide to chick development.		
FROM TFH PUBLICATIONS	*Chicks and Ducks as Pets*		0866224319
	An introductory book, written for pet owners at home.		
FROM WEIDENFELD & NICHOLSON	**Little Book of Ducks*		0297832433
	An illustrated book for young children.		

3. WALLCHARTS and PHOTOGRAPHS

FROM THE DOMESTIC FOWL TRUST	The trust produces a wide range of posters that feature many varieties of poultry, waterfowl and other domestic fowl. Call for details or see the web site.		
FROM PHILIP HARRIS EDUCATION	**Life Cycle Sequences*	A23607	£19.37
	As from LDA.		
FROM LDA (LIVING & LEARNING)	**Life Sequences Cards*	LL00642	£18.99
	40 A5-size full-colour photographs illustrating the life stories of five organisms; one set of these shows the chicken.		
	**Time and Growth*	LL06014	£9.99
	Designed to help children understand the concept of time, the pack contains 60 cards, with colour illustrations rather than photographs, showing changes over time. One sequence depicts the changes from an egg to a bird.		
FROM PICTORIAL CHARTS EDUCATIONAL TRUST (PCET)	**A Chicken Story*	PT T801	£5.99
	A laminated frieze, 21 x 152 cm, using photographs to show the development of a chicken.		
FROM TTS	**Life Sequences Cards*	LSEQ	£18.80
	As from LDA.		
	**Chick Life Story* (as from PCET)	SCHICK	£5.75
	The chick's life story shown in 8 photos in poster format 152 cm x 21 cm.		

4. MODELS

FROM GLS	**Life Cycle Model sets*	332377	£69.99
	Made from tough, inert foam. Designed to be handled by young pupils as part of their studies. Includes the life cycle of the frog, butterfly and flowering plant as well as a chicken. Greatly simplified models show the key features and structures. There is a guide and background notes.		

5. SLIDE SETS

FROM BANTA LTD

Biosets:

The Chick Embryo Z33

How Animals Reproduce From Egg to Embryo ZJG

Biosets are strips of 8 photomicrographs of views taken through a microscope; they are observed using a special Bioviewer. They are more suited for pupils' work in lower secondary schools. Minimum available: Box of 10 for £21.80, excluding VAT. For use with Banta Bioviewers: £7.50 each; discount available on 10 or more.

FROM OXFORD EDUCATIONAL RESOURCES

Chick Embryology AV4 £24.01

26 colour slides, produced by Oxford Scientific Films, charting chick development in some detail. Rather technical; only appropriate for secondary schools.

Window into a Nest AV35 £22.23

24 colour slides, produced by Oxford Scientific Films, which supports work on chicks by illustrating the rearing of blue tits in a more 'natural' setting.

6. VIDEOS

FROM DOMESTIC FOWL TRUST

Poultry at Home £15.95

Incubation £15.95

Keeping Ducks £15.95

Poultry Matters £14.95

Although not seen by CLEAPSS, these videos may be useful for those schools wishing to rear adult chickens or ducks and for those that might value some support in their incubation project. Note that the video prices include VAT.

Some incubator suppliers also produce videos. Check with individual suppliers for their current listing.

7. MULTI-MEDIA MATERIALS

FROM BRITISH EGG INFORMATION SERVICE

Produces a wide range of resources, ranging from an 8-page booklet *Egg Production* (up to 30 copies free) to *The Egg File* (a comprehensive resource file for students of design and technology at GCSE, 1 free copy per school). There are resource banks which can be downloaded from its web site, www.eggsedu.org.uk.

8. ARTICLES

FROM THE JOURNAL of the ASSOCIATION for SCIENCE EDUCATION: *SCHOOL SCIENCE REVIEW*

Chicks in school L Pocock Volume 66, No. 234, September 1984, Page 79

(A collection of ideas for practical activities with eggs and chicks.)

FROM THE JOURNAL of the ASSOCIATION for SCIENCE EDUCATION: *PRIMARY SCIENCE REVIEW*

An eggciting idea Kay Rosie No. 1 Summer 1986, Page 6

Driving us quackers Kay Rosie No. 4 Summer 1987, Page 7

(Accounts of an infant school teacher's success with incubating chick and duck eggs.)

12. ADDRESSES

ASCOTT SMALL HOLDING SUPPLES LTD
The Old Creamery, Four Crosses, Llanymynech SY22 6LP.
Tel: 0845 130 6285; *Tel:* 0870 774 0140
E-mail: sales@ascott.biz *Web site:* www.ascott.biz

ASSOCIATION FOR SCIENCE EDUCATION
College Lane, Hatfield AL10 9AA.
Tel: 01707 283000; *Fax:* 01707 266532
E-mail: info@ase.org.uk *Web site:* www.ase.org.uk

ATP INSTRUMENTATION
Tournament Way, Ivanhoe Industrial Estate, Ashby de la Zouch LE65 2UU.
Tel: 01530 566800; *Fax:* 01530 560373
E-mail: sales@atp-intrumentation.co.uk
Web site: www.atp-instrumentation.co.uk

BANBURY CROSS VETERINARY FARM SUPPLIES
Eden Hall, Southam Road, Banbury OX16 1ST.
Tel: 01295 758504 *Fax:* 01295 758418
E-mail: clivemadeiros@aol.com www.banburycrossincubators.com

BANTA LTD
Unit 9, Burnt Oak Business Park, Back lane, Waldron TN21 0NL.
Tel: 01435 810200 *Fax:* 01435 810210
E-mail: sales@bantabiology.com *Web site:* www.bantabiology.com

A & C BLACK (Distributors Macmillan)
37 Soho Square, London W1D 3QZ.
Tel: 020 7758 0200 *Fax:* 020 7758 0222
E-mail: customerservices@acblack.com *Web site:* www.acblack.com

BRINSEA PRODUCTS LTD
Station Road, Sandford BS19 5RA.
Tel: 0845 226 0120 *Fax:* 01934 820250
E-mail: sales@brinsea.co.uk *Web site:* www.brinsea.co.uk

BRITISH EGG INFORMATION SERVICE
1 Chelsea Manor Gardens, London SW3 5PN.
Tel: 020 7808 9790 *Fax:* 020 7351 5092
E-mail: info@britegg.co.uk
Web sites: www.britegg.co.uk; www.eggsedu.org.uk

CHRYSALIS CHILDREN'S BOOKS
The Chrysalis Building, Bramley Road, London W10 6SP.
Tel: 020 7314 1400 *Fax:* 020 7314 1594
E-mail: childrens@chrysalisbooks.co.uk
Web site: www.chrysalisbooks.co.uk

CURFEW INCUBATORS
Paul Chewter, Unit 1 Butterfly Lodge, Mersea Road, Abberton, Colchester CO5 7LG.
Tel: 07963 969681 *Fax:* 01206 736121
E-mail: paulchewter@netscape.net

DOG HEALTH NUTRITION
Unit 3 Tower Meadows, Castle Acre Road, Swaffham PE37 7LT.
Tel: 01760 726340 *Fax:* 01760 721006
E-mail: doghealth@ukonline.co.uk *Web site:* www.doghealth.co.uk

DOMESTIC FOWL TRUST
Honeybourne Pastures, Honeybourne, Evesham WR11 7QZ.
Tel: 01386 833083 *Fax:* 01386 833364
E-mail: dft@domesticfowltrust.co.uk *Web site:* www.domesticfowltrust.co.uk

DORLING KINDERSLEY
Pearson Customer Operations, Edinburgh Gate, Harlow CM20 2JE.
Tel: 0870 607 7600 *Fax:* 0870 850 1115
E-mail: customerservice@dk.com *Web site:* www.dorlingkindersley-uk.co.uk

FACE (FARMING AND COUNTRYSIDE EDUCATION)
Arthur Rank Centre, Stoneleigh Park CV8 2LZ.
Tel: 02476 853089 and 02476 858261
E-mail: enquiries@face-online.org.uk *Web site:* www.face-online.org.uk

GAMEKEEPA FEEDS LTD
Southerly Park, Binton, Stratford-upon-Avon CV37 9TU.
Tel: 01789 772429 *Fax:* 01789 774875
E-mail: info@gamekeepafeeds.co.uk *Web site:* www.gamekeepafeeds.co.uk

GLS EDUCATIONAL SUPPLIES
1 Mollison Avenue, Enfield EN3 7XQ.
Tel: 020 8805 8333 *Fax:* 0800 917 2246
E-mail: sales@glsed.co.uk *Web site:* www.glsed.co.uk

GRIFFIN EDUCATION
Bishop Meadow Road, Loughborough LE11 0RG.
Tel: 01509 233344 *Fax:* 01509 231893
E-mail: griffin@fisher.co.uk *Web site:* www.griffineducation.co.uk

JOHN E HAITH
65 Park Street, Cleethorpes DN35 7NF.
Tel: 0800 298 7054 *Fax:* 01472 242883
E-mail: seeds@haith.com *Web site:* www.haiths.com

PHILIP HARRIS
Findel House, Excelsior Road, Ashby Park, Ashby de la Zouch LE65 1NG.
Tel: 0845 120 4520 *Fax:* 01530 419492
*E-mail:*customerservice@philipharris.co.uk *Web site:* www.philipharris.co.uk

HATCH-IT INCUBATORS
Palady Spring, Old Andover Road, Newbury RG20 0LS.
Tel: 01635 230238 *Fax:* -
E-mail: sales@hatchitincubators.com *Web site:* www.hatchitincubators.com

ROB HARVEY
Rob Harvey Specialist Feeds, Kookaburra House, Gravel Hill Road, Holt Pound, Farnham GU10 4LG.
Tel: 01420 23986 *Fax:* 01420 23078
E-mail: rob@robharvey.com *Web site:* www.robharvey.com

INSECT LORE
PO Box 1420, Kiln Farm, Milton Keynes MK19 6ZH.
Tel: 01908 563338 *Fax:* 01908 262654
E-mail: sales@insectlore.co.uk *Web site:* www.insectlore-europe.com

INTERHATCH
27, Whittington Way, Old Whittington, Chesterfield S41 9AG.
Tel: 01246 264 646 *Fax:* 01246 268344
In December 2005, this company had no e-mail and no web site.

KORTLANG & KORTLANG
Shepway, Kennington Rd, Willesborough Lees, Ashford TN24 0NS.
Tel: 01233 623431 *Fax:* 01233 624783
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